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VOL. V

FRANCIS RAMALEY
EDITOR

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SCIENTIFIC ASSISTANCE IN LAW-MAKING

By John Burton Phillips

Among the conspicuous features in modern progress none is more important than specialization. This is the era of specialists. In all lines of activity success comes to the man who has had the benefit of special training and has attained excellence in his line of work. Division of labor, which has created specialists, can be employed to some extent in all industries. It has been adopted more generally in industrial affairs than in government, yet there is a pronounced tendency to secure the services of specialists in the administration of the government of the United States. The report of the Industrial Commission was very largely the work of men specially trained in the subjects investigated by that body. This is what gives it its great authority and impartial tone.

One of the largest fields for the effective service of the specialist is in the assistance he can render to the men charged with making a state's or nation's laws. With the increase in the activities of government, both state and national, the difficulties that beset the lawmaker tend greatly to increase. Formerly the legislator had to be posted on a few fundamental subjects only; there was not much wealth, and what there was was more or less uniformly distributed, so that taxation was a simple matter; corporations had not been born; there was no labor problem. All this is changed. Government must now concern itself with minute and detailed social, economic and industrial affairs. Laws must be passed to regulate the quality of food, to prevent child labor and to prohibit the manipulation of our credit institutions. A legislator must be well-nigh omniscient to have an intelligent opinion on all of these subjects. The biennial output of state legislation alone in the United States exceeds twelve thousand acts. Fourteen thousand one hundred and ninety laws and resolutions were enacted in 1901. Several state legislatures pass more than five hundred laws at a session and the average legislative session is not over ninety days in length. How can any man vote intelligently on the passage of so many laws in so short a time?

LENGTH OF SESSIONS AND NUMBER OF ACTS IN 1901

States	Length in Days	Number of Laws and Resolutions
Alabama	113	1,132
Connecticut	160	750
Kansas	61	425
Maine	80	574
Massachusetts	169	652
Michigan	156	517
Minnesota	95	407
North Carolina	86	1,265
Pennsylvania	178	582
Tennessee	79	630
Wisconsin	126	482

The above table shows clearly the enormous amount of work required of the legislator. In Alabama, the average output was ten laws a day, and in North Carolina, almost fifteen. To vote intelligently on so many diverse measures in so short a time, even the wisest man would require unusual assistance.

The average legislator is not a person who has been a special student of the science of legislation. He has been devoting his energies to his business or profession, and because of his ability and good judgment and also perhaps because of his public spirit, tact, personal address and straightforward dealing, is elected and sent to the legislature and intrusted with the responsibility of making laws for his state. He is supposed to do a great amount of work. He is appointed to many committees, and if he attends the meetings of each of his committees and attends the sessions of the legislature, he has no time to do anything else. In the New York legislature, nearly two thousand bills are introduced in each session of the senate and about thirty-six hundred in the assembly. The legislator is obliged if a conscientious man—and no other should be sent to the legislature—to form an opinion as to the merits of a large number of these bills. He needs accurate information on the various matters treated of in these proposed laws and he needs this information quickly. Failure to get it delays law-making and there is already too much delay in this work—at least this seems to be the opinion of the voters.

Lack of experience increases the handicap under which the modern legislator suffers. He is usually unfamiliar with parliamentary procedure

and the preparation of bills. He serves for one or two terms only and, therefore, does not have the opportunity to become familiar with the work of legislation nor to fortify himself against the ingenuity of the lobbyists. This is one of the greatest causes of the inferior legislation of the American states. In many districts the idea that a member shall not serve more than two terms has become firmly established. The ambition to serve a term in the legislature is quite common; such service guarantees high social standing; it also helps one's business or profession. Then, too, it is thought by the politicians that peace and harmony in the organization can be more easily maintained if the legislative ambitions of a large number of aspiring statesmen are gratified with an office that does not bring large monetary returns. Hence, the two-term rule, and hence, also, inferior legislation by inexperienced men.

Few persons have an adequate idea of the extent to which this practice of granting short terms of service to the members of the legislature is carried. In the house of representatives of the state of Michigan are one hundred members. The legislature meets every two years. In the session of 1899, of these one hundred members of the house, only four had served in the same body four years previous. Similar examples might be found in other states.

The results of this custom are that the new member of the legislature is very much in need of assistance if he is to accomplish anything. Imbued with the American idea that law is a remedy for all things, the new members are anxious to get through some piece of legislation. They must have help in the preparation of their bills and the material for their arguments before the committees. This assistance they will secure from someone, and if the state does not provide it for them, those interests seeking favorable legislation will be only too glad of this opportunity to put the unwary legislator under obligations to them.

One of the primary duties of the state is to shield as far as possible its representatives in the legislature from the pressure brought to bear upon them by the agents of interests which desire to secure special legislation or to prevent the passage of laws that will curtail their privileges. Numerous lobbyists are present at each session and the so-called "third house" has become well known in American legislative procedure.

The exposure of the "yellow-dog" fund by the life insurance investigation shows clearly the enormous power constantly exercised by the corporations over legislation. The same investigation also shows the various methods other than direct bribery that are used to influence the votes of legislators. The great New York life insurance companies maintained a sort of clubhouse in Albany for a number of years, and here were to be found attorneys who knew how to make themselves useful to any member of the legislature needing assistance in the preparation of measures he desired to introduce. Temptations such as these are the most dangerous to the public interest because they are so insidious.

It is in supplying prompt information to the legislator that the services of a trained legislative reference librarian are valuable. The aid which such an officer can render has been recognized by the states of New York and Wisconsin. Both of these states have provided legislative reference librarians whose sole duties are to render assistance to the legislative body by furnishing accurate data on such subjects as come up for legislative consideration. Beginnings in this work have also been made in Indiana, California,[1] Maryland and Nebraska.[2]

In New York the Sociology Division, as the legislative reference department of the State Library is called, was established as an adjunct of the law library in 1890. At the head of the division is the Sociology Librarian, a man highly trained in political science and a doctor of philosophy from one of the leading universities of the United States. After a number of years' service at a scant remuneration, this officer's salary has at last been somewhat advanced. He has three assistants. Both librarian and assistants are appointed for life by examinations under the civil service commission. Among the regular duties of this department are the preparation and publication of bulletins. The following have appeared:

PUBLICATIONS OF SOCIOLOGY DIVISION, NEW YORK STATE LIBRARY

Comparative Summary and Index of State Legislation. Published annually since 1890.
Review of Legislation. Published annually since 1901.
Digest of Governors' Messages. Published annually since 1902.

[1] REINSCH, *American Legislatures and Legislative Methods*, p. 297.
[2] *American Political Science Review*, Vol. I, No. 1, p. 102 (November, 1906).

State Finance. Statistical tables giving an analysis of the financial condition of each state in 1890 and in 1895. March, 1897.

Trend of Legislation. A review and discussion of recent state legislation. May, 1900.

Taxation of Corporations in New York, Massachusetts, Pennsylvania, and New Jersey A review and compilation of the corporation tax laws. May, 1901.

Perhaps the most important of these is the *Annual Comparative Summary and Index of State Legislation.* Brief summaries of the laws enacted in each of the states during the preceding year are made and classified. For instance, all the summaries of laws concerning highways are grouped together, as are all the laws concerning various other subjects. Arranged in this way they are published in the bulletin, which thus is a classified index to all the state legislation enacted in the United States during the preceding year. This bulletin is ready for distribution the day the legislature meets, and a copy is placed in the hands of each member. He is in this way advised of what the other states have done along the lines of any new legislation which he may be contemplating. As one of these bulletins has been published each year for sixteen years, it is now very easy for the legislator to know what the states have done in a legislative way during all this period. A consolidated index of the state legislation has been kept in the State Library at Albany and by this means the Sociology Librarian is enabled to furnish the legislator with any information he may desire concerning any legislation in any state during this period.

The Sociology Division of the New York State Library publishes also a review of legislation. This is an annual publication and consists of reviews of the legislation of the various states on certain subjects. Experts in various parts of the country contribute discussions of the new legislation. For instance, the banking legislation was reviewed last year by the New York superintendent of banks, Mr. Frederick Kilburn.

The preceding year's legislation on the following subjects is reviewed in this bulletin:

State Government
City Government
Assessments and Improvements
Roads
Law-making and Elections
Taxation of Mortgages
Inheritance Tax
Taxation of Business Corporations
Taxation of Public Service Corporations
School Organization and Supervision
Common Schools
High Schools

Higher Education
Libraries
Geology and Topography
Charities
Dependent, Neglected and Delinquent Children
The Insane
Feeble-Minded and Epileptic
Penal Institutions
Intoxicating Liquors
Public Health
Food Legislation
Labor
Factory Inspection
Insect Pests and Plant Diseases
Contagious Diseases of Animals
Irrigation
Forestry
Protection of Game
General Business Corporations
Building and Loan Associations
Insurance
Railroad Accidents
Mechanics' Liens
Mortgages
Civil Procedure
Crimes and Punishments

To the legislator seeking information the very great importance of a review and discussion of the legislation on these subjects during the preceding year is at once apparent.

Another annual publication of this division of the New York State Library is the *Digest of Governors' Messages*. This consists of a classification of the various subjects treated by the governors in their annual messages. What each governor has to say or to recommend on a subject is grouped and classified. By consulting this bulletin it is therefore easy to determine what the various governors have recommended concerning such a subject as a primary election law. This is a publication designed to keep the legislator in touch with the trend of opinion of those most likely to be conversant with the need of new legislation.

Among the special duties which the Sociology Librarian performs for the New York legislators, perhaps the most prominent is that of making compilations and furnishing data. Suppose a member wants to introduce a bill fixing the employer's liability for industrial accidents. This is a rather complicated subject and one that needs careful study in the arrangement of the details of the proposed law. The legislator wants data. He wants to know something about the English, French, German, Austrian and Belgian laws on this subject, as well as the laws of the other states of the Union. All this data will be delivered to him upon his application to the Sociology Librarian. The librarian's business is to keep track of all these things and thus anticipate the needs of the legislators.

The Sociology Librarian in New York tries to keep posted on the legislative movements of the various states. He makes an effort to keep track of the bills which fail to become laws. For this purpose he subscribes for a newspaper in each state during the legislative session, cuts out the news items that may be of interest to lawmakers and keeps them on file. These clippings are another means of keeping in close touch with the trend of legislative opinion.

The legislative reference department of the state library of Wisconsin is comparatively new, having been organized during the latter months of 1901. The librarian devotes himself to the collection of the various state reports and compilations which will enable him to have at his command the data desired by the legislators. All the bulletins issued by the New York State Library are in his possession, so that he practically has the consolidated index of all legislation in the United States since 1890. He is therefore able to render to the legislators of Wisconsin the same service that the Sociology Librarian renders to those of New York.

Owing to the activity and alertness of political life in Wisconsin this department has had an amazing growth, having employed during the winter of 1906 and 1907 fifty-three persons, about twenty of whom are the regular employees. The entire department is purely non-partisan and strictly a civil service affair. All the work of the department is clerical, and consists in aiding the legislators in such manner as they desire. The department is conducted on the following plan: One group of clerks gathers the comparative data and the laws from the other states; another group collects the economic data of a political nature relating to these laws; a third group gathers and compiles judicial decisions and critical data of a legal nature. The material collected by these groups is arranged and classified by special clerks. There are also three draftsmen who work with the librarian and devote themselves exclusively to the preparation of bills. The usual appropriation for the department was increased by $15,000 in 1907. The following bulletins have been issued.

PUBLICATIONS OF THE LEGISLATIVE REFERENCE DEPARTMENT OF THE WISCONSIN STATE LIBRARY

Railroad Co-Employment
Lobbying

Corrupt Practices at Elections. Contributions and Expenditures
Exemption of wages
Municipal Electric Lighting
Trust Company Reserves
Taxation of Trust Companies

These are comparative legislation bulletins and contain references to the literature, definitions, a history and digest of the legislation on the subject and compilations of the laws of the various states, with judicial decisions.

In the establishment of such a department in other states, it will not be necessary to duplicate all the work that has been done in New York or Wisconsin. Much of the work of the Sociology Librarian in these states has been published and comparatively small expense would be incurred in arranging a consolidated index of all the laws passed in any state since 1890. This index could easily be prepared from the annual bulletins issued by the State Library at Albany. The business of such a librarian would be to make this information accessible to the members of the legislature. He should keep track of the new legislation and keep on file the session laws of the various states. No small part of his energies will be required to collect these laws. The states are painfully slow in printing their session laws and still more painfully slow in their distribution. The legislative reference librarian should also collect assiduously all the pamphlets and other material which he can get track of on the various subjects concerning which there is likely to be legislation in the near future. A classified collection of material of this sort is of inestimable value to the legislator.

There might also be combined with the duties of Sociology Librarian the work of drafting bills. This is such an important function that some provision should be made to insure that the bills be properly drafted before they are introduced into the legislature. It is unsafe and very expensive to leave the drafting of bills to the individual members. Confused, verbose, and unconstitutional legislation is very apt to result, and this entails needless labor on the courts, and delays the progress of needed reforms. In Connecticut, New York and South Carolina there are bill-drafting commissions. There is a supervisor of bills in New Jersey,[1] and a legislative reference librarian in Wisconsin.

[1] Reinsch, *op. cit.*, p. 328.

Connecticut passed a law in 1882 providing for the appointment of a clerk of bills by the president and secretary of the senate and the speaker of the house. His duties are thus prescribed:

It shall be the duty of the clerk of bills to examine all bills for public acts and resolutions, in respect to their form, before the same are reported favorably by the committee to whom they have been referred, and under direction of such committee to prepare such amendments or substitute bills or resolutions as may be deemed necessary or advisable.[1]

In 1895 the appointment of the clerk of bills was taken from the president and secretary of the senate and speaker of the house, and vested in the joint standing committees of the judiciary and engrossed bills and his duties specified.[2]

In 1901 this act was revised but the manner of appointment of the clerk of bills is not changed. His duties are as follows:

§ 2. It shall be the duty of the clerk of bills to assist members of the general assembly in drafting bills for public acts and resolutions of a public nature, and to prepare amendments to or substitutes for bills or resolutions at the request of committees.

§ 3. Every bill or resolution favorably acted upon by any committee of the general assembly shall, before being reported to either branch thereof, be first submitted to the clerk of bills who shall examine such bill or resolution in respect to its form for the purpose of avoiding repetitions and unconstitutional provisions and insuring accuracy in the text and references, clearness and conciseness in the phraseology, and the consistency of statutes; and shall return to the committee submitting it any bill or resolution that is not in correct form, with such corrections as he may propose in the form of a substitute or as amendments.[3]

By an act passed by the legislature of the state of New York in 1893,[4] the Statutory Revision Commission was required on request of any committee or member of either house of the legislature to draft or revise bills or render an opinion as to their constitutionality or other legal effect. The legislators did not avail themselves of the assistance thus offered to any very great degree. However, the value of such assistance was recognized by a few leaders in the legislature and when the Statutory Revision Commission was abolished in 1900,[5] a new act was passed providing for expert help in the drafting of bills. A bill-drafting commission composed of three persons is appointed by the president *pro tem* of the senate and the speaker of the assembly. These persons are directed to

[1] *Laws of Connecticut*, 1882, chap. 137.
[2] *Laws of Connecticut*, 1895, chap. 297.
[3] *Laws of Connecticut*, 1901, chap. 1.
[4] *Laws of New York*, 1893, chap. 24, par. 2.
[5] *Laws of New York*, 1900, chap. 664.

prepare bills at the request of the committees or members of either House.[1]

There is also a sort of bill-drafting commission in South Carolina. In 1868 the attorney-general was instructed to assist in the preparation of legislative documents and bills when requested by either house.[2] In 1880 he was empowered to require the aid of the state solicitors[3] in the eight judicial districts to assist him in this work.[4]

In the legislative reference division of the State Library of Wisconsin there are three draftsmen, and although all bills introduced are not required to be submitted to them, the draftsmen have proved so useful that, as a matter of fact, about nine-tenths of the bills pass through their hands before becoming laws.

The preparation of a bill is a work requiring great skill and efficiency that can come only as the result of experience. The parliament of England has had for long years a bill-drafting expert. No bill is introduced in that body that has not been through the hands of the official draftsman. He is thoroughly learned in the common and statute law, and is thereby able to give the proposed statute its most effective form. Hence the lucidity and conciseness of the British statutes as compared with the common obscurity of the product of the American legislatures.

The attainments necessary to a legislative draftsman have been thus stated:

> It is not enough to attain to a degree of precision which a person reading in good faith can understand; but it is necessary to attain, if possible, to a degree of precision which a person reading in bad faith cannot misunderstand. It is all the better if he cannot pretend to misunderstand it.[5]

A legislative draftsman is more necessary in America than in England, as here the form of government is determined according to the doctrine of the balance of powers, and as the supreme courts in the various states have the power to declare acts of the legislature unconstitutional, it is all the more important to have the law in constitutional form when it is

[1] *Laws of New York*, 1901, chap. 88.

[2] *South Carolina Statutes at Large*, Vol. XIV, No. 3.

[3] *South Carolina Statutes at Large*, Vol. XVII, No. 249.

[4] WHITTEN, *Review of Legislation* (New York State Library Bulletin, No. 72, p. 30).

[5] Justice Stephen, quoted in REINSCH, *op. cit.*, p. 328.

presented to the legislature. In England this is not so important as whatever Parliament enacts into law remains the law of the land till repealed by the body enacting it. The great number of laws declared unconstitutional each year in the American states is very good evidence that they were presented to the legislature without careful examination by an expert. Of the laws passed during the five years preceding 1902 in New York, thirty-nine had been declared unconstitutional by March of that year. It is said that in New York while the members of the Assembly make considerable use of the draftsmen's services, the senators disdain to employ them and therefore much of the defective and unsatisfactory legislation owes its origin to the upper house.[1]

There is reason to believe that the legislative reference librarian is the logical person to be intrusted with the drafting of bills. As his work includes keeping track of and classifying all the laws declared unconstitutional in any state, in the course of time his judgment should become exceptionally valuable as to the likelihood of any proposed measure running the gauntlet of the courts. His constant study in compiling, digesting and indexing statutes should also render him familiar with the most concise form in which laws should be drawn, and thus make him a most efficient legislative draftsman. It is quite certain that if all bills were required to be submitted to the draftsman, as is now the case in Connecticut alone, much error, confusion and unconstitutionality would be eliminated from the legislative product of the various states of the American Union.

Important as is the work of legislative reference librarians, it is unlikely that such assistance will be speedily secured by the legislatures of the American states. The office will not be created till the general usefulness of this kind of assistance is thoroughly understood. Even then there will be much opposition to appropriations for the work. The interests seeking special legislation are unwilling that a bureau of information should be established for the purpose of furnishing arguments to the members of the legislature. A well-informed legislator is harder to persuade. That the interests desiring favorable action by the legislature understand this is clearly shown by the record of their opposition to these

[1] REINSCH, *op. cit.*, p. 328.

acts. Even after the legislative reference librarian is appointed, the salary is apt to be kept for a number of years at a very low figure. He who desires to become a legislative reference librarian must be imbued with the spirit of the missionary and realize that he must educate both the legislature and the public to an appreciation of his usefulness.

THE RELATION OF THE COMPOSER TO MUSICAL FORM

By George M. Chadwick

To the casual observer the choice of a form for a composition by the composer is largely a matter of demand on the part of the publisher, the public or of convenience to the composer himself. But the musician comprehends a more vital relation of the composer to his art—a relation which, in proportion to the depth of his life and of his musical genius, makes it impossible for him to recognize, at least in his greater compositions, any demands outside his own musical conscience. As Spinoza ground lenses in order to avoid any necessity of being influenced in his writings by financial reasons, so must the composer have the courage to refuse to recognize any demands which would divert his creative energy from pursuing its high ideal. He who has a message to the world *must* deliver it and no other. A curse of modern times is that those having no great truths to utter are applauded for being "clever" or "delightful," for being "charming" gentlemen, and for so well conforming in every particular to the "exquisite art" of the drawing-room. The merely conversational in letters and in art is recognized today in a manner out of all proportion to its lack of real value. Especially is this true in this country where superficial ideas are less condemned than in older nations. As a nation we are apt to overrate our musical culture when we view with pride the amount of money spent on concerts, the opera and recitals, to say nothing of that spent on musical education with little regard to the real value of the instruction, if only it leads to "graduation." Alas, the magic power of that word "graduate," and the incalculable harm it has done to the cause of a thorough study of music! While it would be unjust to condemn the public patronage of concerts, etc., as insincere—for even a conservative musician must be somewhat optimistic on this question—nevertheless it is true that the attitude, at least of the "society world," is one too often of idle curiosity: the desire to hear this or that much-talked-of virtuoso or opera singer; the real harm being that this class do much to create public opinion, a task too serious

and too important to be consigned to such incompetency. The relation of the artist to the art-patronizing spirit of society reminds one of Carlyle's reference to the lion invited to the feast of chick-weed—either the lion ate nothing or else devoured the chickens.

What is art? Is it a something to amuse, to entertain merely, to be purchased by those who cannot comprehend the sacrifices, the hardships, the heroic sincerity of genius? Genius might well exclaim with Hamlet:

> If thou didst ever hold me in thy heart,
> Absent thee from felicity a while,
> And in this harsh world draw thy breath in pain,
> To tell my story—

In music "the style is the man," being neither accidental nor self-chosen. The lark was not taught its song—being a lark it sang ever thus. Plato's saying that "he who is his own master knocks in vain at the doors of poetry," is too deep for those who would according to fixed rules make respectable citizens of all mankind; but to those to whom the meaning of these words has been revealed, the relation of creative genius to art appears no longer as a matter of the mere intellect in its choice of a form of expression. Mere talent listens to the voice of those in authority, to the dictates of publishers and public, even boasting of its diplomacy; but genius knows but one command, and that command is its own conscience.

Musical form is not in its true sense the process of shaping a composition from without according to established rules, but is an inner force self-contained within the music itself, inseparable from the spirit of music; and therefore the relation of the composer to form is one of the heart rather than the head; an unconscious recognition of all that is included in a perfect work of art; a recognition due to an intuitive poetic insight rather than to reason. If we trace its development historically we find that it is as impossible to separate it from the outer influence of the social, political and musical condition of any particular period, as to isolate genius itself from the forces of heredity, nationality and the spirit of its time. But great genius becomes more and more isolated as it penetrates yet deeper the mystery of art, and form, that objective phase of the subjectivity of music, at last seemingly transcends itself, so that

we have, as in the case of some of Beethoven s last compositions, what are erroneously considered as instances of the bursting of the bonds of form by the composer. This is a contradiction, since form never having enslaved the genius of Beethoven, it is impossible that he could defy its limitations; the truth being rather that form became so transcendent, so spiritualized, that it no longer existed as an objective phase of art in its perfect union with the subjective nature of music itself.

"The style is the man," but what is the meaning of this in music? That is even more difficult to answer than in its original literary sense, for music as a medium of expression is infinitely more subtle than the medium of spoken or written language, and to attempt an explanation would be to involve the reader in an exhaustive essay on musical aesthetics, on the psychology of musical sensation—a field of psychological research but little developed in its larger sense; and to invite an endless amount of discussion on the subject of the relation of music and the plastic arts to the art of poetry and to general literature, to say nothing of the confusion of ideas relative to the relation existing between music and the other arts. Let us therefore take for granted that the symphony is the greatest form in purely instrumental composition, and that the opera, and especially the musical drama of Wagner, is greater than the simple *Lied*, and from this standpoint arrive if possible at just conclusions. It is safe to say that the form of composition in which a composer ultimately attains to his highest possible ideal indicates his attitude toward music, and his success in that particular form measures the real power of his creative genius. But what I feel as a serious mistake in most textbooks on musical form, is the attitude toward form as a subject to be learned as one would learn the rules of grammar, and the compositions, for example of Beethoven, are cited to illustrate his increasing mastery of form as he advanced from his earlier to his latest compositions, whereas it was the development of the wonderful resources of his musical nature, a development containing within itself those forces of its outward expression as the growing tree expands its bark which is a part of the living tree and not a mere covering. In this sense the composer does not choose his form, it is inseparable from the music itself. Key relationships, contrasting *tempi*, and the treatment of principal and

secondary themes are all included in the musical inspiration itself, a truth still further developed by Wagner when he insists that a correct understanding of the "Melos" (meaning melody in all its phases) is alone the true guide to a proper *tempo,* the one implying and qualifying the other; and that a failure to understand the "Melos" inevitably results in a failure to determine the proper *tempo.* This being true of the thematic material of a composition, how vital and far reaching it is when applied to not only the thematic but to the entire musical contents of a composition. Viewed from this standpoint those opinions of a composer and his compositions—opinions based upon the mere technical rules of form—are of little value, and often do much harm owing to their seeming value because appearing very scholarly. Schumann once said that most critics are either disappointed executants or composers—but we are not speaking of critics.

No great composer ever seriously erred in his form of expression after he had mastered the musical and technical material of his art. How Beethoven must have enjoyed as a huge joke the learned explanations and criticisms of his compositions by those who were still talking about the sacred rules of art, who sometimes, like the watchman in *Die Meistersinger,* come forth and announce in a peaceful voice that all is well, or else like Beckmesser they squeak forth that all is wrong—or something to that effect.

But this inner relation of the composer to his art has a yet deeper significance, for in its full development it becomes an exact statement of his spiritual insight, and of his attitude toward not only art but life. I use the word spiritual in its broad sense. The composer of merely light operas or popular piano music could never be pardoned for saying that he *could* write a symphony if he wanted to. If he had the genius to compose a symphony no power could hinder him. Even the prospect of starvation is no obstacle to genius when it has a great message to the world. It is only the man of talent, the mere conversationalist, who is always talking about what the public wants and what he must compose in order to earn a living. The life of even Beethoven was all too brief, and toward its close he exclaimed, "I feel that I have but just begun!" How brief then in reality is the life of a lesser genius than Beethoven—

tragically brief, when we consider all the lessons to be given and the duties attended to in order that the man of genius may be allowed to dwell on this earth and at last be buried, possibly, as was Mozart—in a pauper's grave. Such a man may feel that had a less unkind fate ruled the outward destiny of his life he could have composed more and possibly greater works; but he also knows that no misfortune could injure the purity of what he has created, and that because he has struggled his creative work has been nobler, truer art: he at least has remained true to himself.

In the matter of his musical personality every great composer has remained true to himself. In the sense that the great current of world energy is far too powerful to be resisted by any individual, however great, have all men of genius been children of their own age. Especially is this true of the composer, for his art can only become known to the world through the co-operation of others, executive musicians (soloists or in orchestras). The Beethoven symphony would have been impossible even less than a century earlier, and the genius of Wagner, in spite of its power to assert itself, could not have expressed itself in the eighteenth century. But neither Beethoven nor Wagner could have been like Meyerbeer or Rossini. The "heaven storming genius" of Beethoven would under any circumstances have defied any power that opposed its approach to its high ideal.

Were I asked to name one serious menace to art at the present time, I would say, that it is the cowardly attitude of the composer toward his art and the public, as paradoxical as such a statement would seem in an age when, were we to judge by the seemingly heroic attempts of musicians to be original, to defy all the art of the past, we must consider this an age of gods rather than men. But is this striving for originality really heroic? Is it not in truth more often a confession of weakness, of the lack of creative power and the desire to conceal poverty of musical thought beneath the glorious power and tone color of the modern orchestra? For a time this may deceive the general public but it cannot deceive the musician acquainted with that wealth of composition inherited from a wonderful past. New forms have developed today, some of which began in the period of pure romanticism, while others are yet more modern, but

not all of them are vital, and it is a question whether the word form can be applied to many of the so-called "tone pictures"—not that they are without form, but that the titles (the inscriptions or "plots") have no vital connection with the music itself. One is sometimes reminded of the words of a certain criticism on one of the great modern German composers (though in that case the criticism was very unjust), "He approaches you, and in a mysterious manner talks about the weather." There is more of mystery expressed by the 'cellos and double basses in unison in the first eight measures of Schubert's B Minor Symphony than in whole pages of the discords and "invented" orchestration of some modern composers.

In addition to the valuable research in the science of sound by Helmholtz and others, we must recognize that of modern psychologists, all of which has tended to correct serious errors in theories on musical aesthetics. In a general way it may be said that all, and much more than has been explained by science, which is of any real *musical* value, has long been understood intuitively by composers. What is here referred to is the effect produced on the emotions by various rhythms, *tempi* and dynamic means, and especially by the different tone colors—for example in the orchestra of the horns, trombones, wood-wind instruments, violins, etc. The artist feels and knows because he is an artist, those facts and subtle phases of the relation of his art to the emotions which other men arrive at, often only in a very limited sense, through reasoning or scientific research.

We can only view at a distance the godlike genius of Bach or Beethoven, but there are others—men of rare genius whom we can approach nearer, understanding why and how they worked. Among these Mendelssohn was a supreme master of form, a true artist. The truth that after all it is the soul's deep message in music rather than the form in which that message is given to the world that is the final test of composition, is emphasized by the fact that time as it records the opinions of musicians relative to Mendelssohn, is being less and less influenced by his artistic perfection in the final judgment of him as a composer.

It would be interesting to prove more clearly this relation of the composer to musical form by giving illustrations from the works of the com-

posers from Bach to Brahms and even later, but is it the purpose of this article merely to call the attention of the reader to general principles; to speak of the relation of the composer to his particular historical period, and above all of that relation existing between the soul of the composer and his art. To comprehend this last relation would be to comprehend one of the profoundest problems—a problem which the philosophers themselves approached with grave questionings. Wagner himself felt that Schopenhauer arrived nearest the truth in his great work, "Die Welt als Wille und Vorstellung," in which he recognizes as Wagner says,

in music itself an idea of the world, since whosoever could completely elucidate music, or rather translate it into rational concepts, would at the same time have produced a philosophy explaining the world.

In referring to Beethoven's dedication of his "Sinfonia Eroica" to Bonaparte (a dedication which he afterward destroyed when Bonaparte declared himself Emperor) Wagner says:

None of our poets has ever designated the tendency connected with one of his principal works in so marked a manner: yet what aid can such a plain indication give us in judging of one of the most wonderful of musical creations? Can it explain a single bar of that score? Is it not sheer folly to think seriously of making such an attempt? I believe the most positive information we may get about the man Beethoven will, at best, stand in the same relation to the musician Beethoven as General Bonaparte stands to the "Sinfonia Eroica." From this point of view the great musician must ever remain a perfect mystery.

That deep relation of the genius of Shakespeare, Goethe or Beethoven to art and to the world can only be revealed in its full sense to a few of the greatest souls; but to all there come partial visions of it as their lives become enriched by study, experience, sacrifice—and sorrow.

In conclusion I feel it a privilege to quote the following from *The Symphony since Beethoven*, a masterly work by one of the greatest living orchestral conductors, Felix Weingartner.

I have now spoken of the modern composers also, chiefly of Strauss and Mahler, who, standing still in the middle of their creative work, lead our thoughts on from the present to the future. Whether there will come an artist, who in his own way can carry on further the work of Berlioz, Liszt, and Wagner, and worthily bring to a close the ranks of our great geniuses, no one today can tell.

But we need not hinder our imaginations from picturing him as he would appear in our day. I think of him first as independent of all parties, and not meddling with them because he is above them. I think of him, not narrow-mindedly German nor yet

cosmopolitan and shallow, but having a strong, purely human feeling, because music is a universal art. I picture him inspired with a glowing enthusiasm for what the great minds of all times and of all nations have produced, and having an invincible aversion to mediocrity, with which he comes in contact only through his own kindness. I think of him as free from envy because conscious of and trusting in his own worth, far above any mean ways of advertising his own works; profoundly sincere, and, where needful, even indifferent—hence not a great favorite in many places. I imagine him not anxiously avoiding social intercourse, but with a tendency towards seclusion—not hating men in exaggerated world-grief, but despising their meanness and narrow-mindedness, and so choosing only special persons for his daily intercourse. I think of him as not indifferent to success or failure, but refusing to allow either to alter his course by a hair's breadth; very indifferent to so-called public opinion, and politically a republican in Beethoven's sense.

* * * * * * * No doubt in the midst of all this confusion, the great, the truly new and original, is silently preparing, but far away from the art market. Its appearance will be a question of personality and not of education. The artist cannot live far from the activity of the world. He must get his ideas, his inspirations, and the plumb-line of his work from life. Will our present most intense, nervous, and strenuous existence let some soul develop within, in the midst of all the press and drive, that degree of intuitiveness and poise from which alone great works of art, stamped neither more nor less with the fad of the day, can come? Will—without reaction—that loftiness without pathos, that charm without coquetry, that strength and sweetness of spirit, by which our great masters were characterized, return to day upon the basis of the modern philosophy of life? In this age of invention and mechanics is an art possible that, standing as far above all time as everything really great does, is still the child of its time?

* * * * To only a few is it permitted to wander on the highest summits of humanity, and this "superhuman" state cannot be constructed, learned, or acquired. That endowment comes only as a transcendent gift from the regions above. "From which?" you eagerly ask. Well,—from that region which only he would deny who has never felt its breath wafted across to him! Be it a little song or a great symphony that you compose, it will only be a masterpiece if it deserves the same motto that the great Beethoven wrote on the score of his *Missa Solemnis:*

"Von Herzen—möge es zu Herzen gehen!"

AN EARLY COLORADO NATURALIST—DENIS GALE

By Junius Henderson

In a state as young as Colorado, where the study of natural history is in a sense in its infancy, one who began his work upon any portion of the flora or fauna twenty-four years ago may well be considered a pioneer naturalist. This is particularly true if his special line of work is one scarcely touched by others. It is doubtful if anyone has spent more time in the study of the life-histories of our mountain birds than did Denis Gale, and but few have done any notable work in this line. His work in Colorado began in 1883, and although it only continued for eleven years, yet he spent so large a portion of each year in the field that he was able to accomplish much. Therefore he may well be called an early Colorado naturalist and a pioneer in oölogical investigations—not a mere collector of eggs, but a close and earnest student of nesting habits, food habits, migration, etc.

Mr. Gale was born in London on August 10, 1828, came to America in about 1833, living first in Quebec, then in Albany, then in Philadelphia, and finally in Denver, where he passed away on February 26, 1905, in his seventy-seventh year. A natural love for birds was quickened by travels amid logging camps near Quebec while but a boy. The beauty of the birds and their songs must have appealed with peculiar force to his naturally artistic temperament. He learned to love the solitude of the forest, and the desire to get out into undisturbed nature continued with him to the end, leading him often to the almost unbroken silence of our mountain slopes above timber line.

In Albany and Philadelphia he followed the career of a dealer in and teacher of art and acquired some distinction in that line of work, having twice at least had charge of important art exhibits. In 1881 he acquired mining interests at Gold Hill, Boulder County, Colorado, and spent a large part of each year there, but continued to call Philadelphia his home until 1892, when he moved to Denver with his family.

In a report of his death written about two years ago occurs this language:

> The name of Denis Gale will bring to the minds of many ornithologists, particularly those who have worked in the mountains of Colorado, the picture of an elderly gentleman whose energy in bird study knew no bounds, who was willing to brave wind and heat and cold and storm in his tramps from valley groves to snow-clad mountain crests in the interests of ornithology, whose collections have helped enrich the splendid collections of Smithsonian Institution and whose notes were of great assistance to Captain Bendire and others, for Mr. Gale, while always willing to furnish information to others, was not much given to publishing his observations himself.[1]

Another account in the same issue of *The Auk* concluded as follows:

> In the history of our state the name of Denis Gale will be recorded as a faithful, enthusiastic bird student, and the memory of his life and work among us will ever serve as an impetus to us younger bird students to take up the work where he left it and do our little part in carrying it to completion.[2]

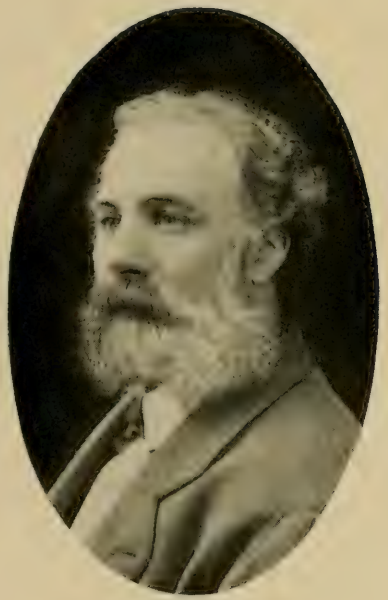
In this connection it is interesting to note also the following paragraph in a letter to the writer from Mr. Gale's daughter, Dr. M. Jean Gale, under date February 7, 1906:

> The few times I had the pleasure of accompanying my father on any of his trips I was especially struck with his untiring patience in searching out the habits and nesting places of his feathered friends. In some way they seemed to recognize that he was their friend, going over the same locality year after year as he did. His success in the finding of Clarke's crows' nests was obtained only by weeks and even months of careful observation of the knowing birds before the nest was even constructed. Notwithstanding the large number of eggs taken and prepared by him, not one was taken ruthlessly or where the nest could not be refilled the same season. It was a labor of love from his first youthful efforts until the more enduring ones in Colorado were finished. It seemed eminently fitting that as he was quietly laid to rest, the air should be filled with low, soft twitterings of a host of feathered harbingers of spring—his friends until the last.

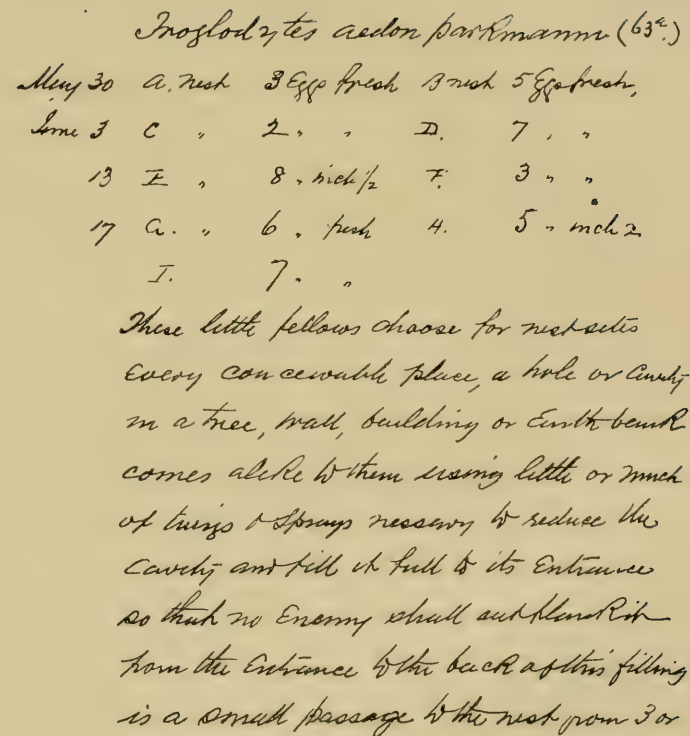
Denis Gale's work in Colorado was, as his notes show, confined chiefly to the foothills and mountains of Boulder County and southern Larimer County, with occasional brief excursions to the adjacent plains in the same counties. One familiar with the region in which he worked and the wide scope of country covered by him, with its numerous streams flowing in canyons hundreds and often two thousand feet below the crests of the divides, may appreciate the wearisome toil of passing from stream to stream and from divide to divide in his search for birds, often following

[1] JUNIUS HENDERSON, "Dennis Gale," *The Auk*, Vol. XX, October, 1905, p. 422.

[2] A. H. FELGER, "Denis Gale," *The Auk*, Vol. XX, October, 1905, pp. 442, 443.



Denis Gale—1828-1905



Troglodytes aedon parkmanni (63a.)

May 30	A. nest	3 Eggs fresh	B nest	5 Eggs fresh,
June 3	C "	2 " "	D.	7 " "
13	E "	8 " inch ½	F.	3 " "
17	G. "	6 " fresh	H.	5 " inch 2
	I.	7 " "		

These little fellows choose for nest sites every conceivable place, a hole or cavity in a tree, wall, building or earth bank comes alike to them using little or much of twigs & sprays necessary to reduce the cavity and fill it full to its entrance so that no enemy shall out flank it from the entrance to the back of this filling is a small passage to the nest from 3 or

Specimen Page of one of Mr. Gale's Small Note Books

them in their flight from canyon to divide to discover their nests. It must be remembered, too, that his labors in this field continued until he reached the age of sixty-five years and were only stopped by an injury to his knee which incapacitated him for climbing the steep slopes of mountain gorges. He made frequent excursions to the St. Vrain, Little Thompson, Big Thompson, and even as far north as the Cache la Poudre, almost always on foot, stopping wherever night overtook him and welcome at any ranch house or miner's cabin, for he was genial, interesting and well informed. He was reticent concerning his natural history investigations except with those whom he recognized to some extent as kindred spirits and with whom he was very modest about his work. Men whose interests were almost entirely centered upon business affairs and who knew him well in a business way had not even the slightest knowledge of his love for nature, and expressed their surprise when the fact became public at the time of his death. Even of his acquaintances who knew of his work among the birds few had any real idea of its extent or thoroughness.

In the mountains he made the acquaintance of many birds whose life-histories were not well known. His observations on the nesting and food habits of the Clarke crow, dipper, cross-bills, Rocky Mountain screech owl (which was named in honor of Mrs. Maxwell, another early Boulder County naturalist), sparrow hawk, red-naped and Williamson sapsuckers, pigmy nuthatch, Townsend solitaire and Audubon thrush, are particularly interesting and valuable.

When Captain Charles E. Bendire began the preparation of his great work on *Life Histories of North American Birds*,[1] he entered into a correspondence with Mr. Gale which continued for several years. As a result we find that more or less extensive notes from Mr. Gale on at least twenty-two species appear in the two parts of that work published, as follows:

A. O. U. No.
289 *Colinus virginianus*—Bob-white.
297 *Dendragapus obscurus*—Dusky grouse.

[1] Charles Bendire, *Life Histories of North American Birds with Special Reference to Their Breeding Habits and Eggs*, Special Bulletin U. S. National Museum; only two parts issued, 1892, 1895, when his death stopped the work.

304 *Lagopus leucurus*—White-tailed ptarmigan.
308*b* *Pediœcetes phasianellus campestris*—Prairie sharp-tailed grouse.
333 *Accipiter cooperi*—Cooper hawk.
349 *Aquila chrysætos*—Golden eagle.
356 *Falco peregrinus anatum*—Duck hawk.
372 *Nyctala acadica*—Saw-whet owl.
373*e* *Megascops asio maxwelliæ*—Rocky Mountain screech owl.
375*a* *Bubo virginianus pallescens*—Western horned owl.
393*e* *Dryobates villosus monticola*—Rocky Mountain hairy woodpecker (as *D. v. hyloscopus*).
394*b* *Dryobates pubescens homorus*—Batchelder woodpecker (as *D. v. oreœcus*).
402*a* *Sphyrapicus varius nuchalis*—Red-naped sapsucker.
404 *Spyhrapicus ruber thyroideus*—Williamson sapsucker.
457 *Sayornis saya*—Say phœbe.
459 *Nuttallornis borealis*—Olive-sided flycatcher.
464 *Empidonax difficilis*—Western flycatcher.
466 *Empidonax traillii*—trail flycatcher (as *E. pusillus*).
468 *Empidonax hammondi*—Hammond flycatcher.
469 *Empidonax wrightii*—Wright flycatcher.
478*b* *Cyanocitta stelleri diademata*—Long-crested jay.
491 *Nucifraga columbiana*—Clarke crow.

Some of the articles were first published in *The Auk*, and only the more important items of his notes were used in each case. Mr. Gale's notes are quoted to some extent in Professor Cooke's bulletins on birds of Colorado, and have been recently used by the present writer in several articles for *The Auk*, *The Condor*, and *Bird Lore*. Altogether his notes discuss 163 species of northern Colorado birds, including those mentioned above, and definitely add twelve species to the hitherto recorded avifauna of Boulder County, as follows:

4 *Colymbus nigricollis californicus*—American eared grebe.
312 *Columbo fasciata*—Band-tailed pigeon.
368 *Syrnium varium*—Barred owl.
467 *Empidonax minimus*—Least flycatcher.
488 *Corvus americanus*—American crow.
524*a* *Leucosticte tephrocotis littoralis*—Hepburn leucosticte.
588 *Pipilo maculatus arcticus*—Arctic towhee.
614 *Iridoprocne bicolor*—Tree swallow.
616 *Riparia riparia*—Bank swallow.
703 *Mimus polyglottos*—Mocking-bird.
756*a* *Hylocichla fuscescens salicicola*—Willow thrush.
769*a* *Sialia mexicanus bairdi*—Chestnut-backed bluebird.

The foregoing species are definitely noted by him in such a way as to show clearly that he had seen or taken them, but the following occur in a list of Boulder County birds in one of his notebooks, with nothing to indicate that he had seen them or to show the source of his information, so that they cannot be considered safe records and should not on this anthority alone be included in the Boulder County list:

190 *Botaurus lentiginosus*—American bittern.
223 *Phalaropus lobatus*—Northern phalarope.
348 *Archibuteo ferrugineus*—Ferruginous rough-legged hawk.
358 *Falco richardsonii*—Richardson merlin.
422 *Cypseloides niger borealis*—Black swift.
429 *Trochilus alexandri*—Black-chinned humming-bird.

We have other records of the eared grebe, crow, arctic towhee, mocking-bird, chestnut-backed bluebird, northern phalarope and Richardson merlin, which had not been published and are now given to the public for the first time, thus confirming Mr. Gale's notes as to them. The American bittern and ferruginous rough-legged hawk probably also occur in this county, but have not been recorded and we know of no actual specimens taken or seen. It is not safe to add them to the list of known Boulder County birds merely because they appear in a list written by him for his own guidance, not intended for publication, not specifying whether he saw the species or the source of his information and of species not elsewhere mentioned in his notes, especially in view of the fact that the list includes the black swift and black-chinned humming-bird, two species of southwestern Colorado which no ornithologist would place with our fauna unless very positively identified and the circumstances of their identification known. It is inconceivable that Mr. Gale actually saw or collected the swift or the humming-bird mentioned, which would have been new to him, without mentioning the fact in his daily notes with the particulars, as his notes on such occasions are usually copious.

Captain Bendire's estimate of the care and accuracy of Mr. Gale's observations and excellence of his preparations is clearly shown in many of his letters, from which we reproduce the following extracts:

Dec. 16, 1889

. . . . I don't agree at all with you that you have so much to regret about the restricted limits and poverty of your observations and that you can't furnish anything much

that is new. . . . . And especially about the white-tailed ptarmigan. You know lots about that bird if you will only tell it. . . . . Don't be too modest please and let me know anyhow something about the species coming under consideration as far as you can. It will be more to the point than the observations of most people that profess to know a great deal more about such matters than you do. . . . .

Dec. 5, 1889

. . . . There are few men today who are as careful in their observations as you are, and I want to make the most I can of their knowledge. . . . .

Dec. 13, 1889

. . . . There are few as close observers as yourself. I want to quote you as often as possible, because I know that your observations are thoroughly reliable in every way.

April 28, 1888

. . . . I always look forward with a great deal of interest to your captures, which aside from their rarity are by far the finest prepared specimens both as regards to the eggs as well as to the preservation of the nests, that we receive from anywhere. . . . .

Regarding the statements in the first of the foregoing quotations, the correctness of Bendire's surmise is shown by the fact that Gale's unpublished notes are very copious on some of the very birds concerning which the former was inquiring in his several letters. The correctness of the statements of the last quotation is further shown by the fact that the numerous nests and eggs in the University of Colorado cabinets which were collected by Mr. Gale include rare species and are most beautifully prepared and packed, so that none thus far opened has been found damaged in the slightest particular after having been moved several times and stored in at least two different places.

Although his work in the field was chiefly with birds and his notes scarcely mention anything else, letters from Captain Bendire and Dr. C. H. Merriam found amid his correspondence indicate that he did some rather important work with mammals. Two new species found at Gold Hill are placed to his credit—Gale's Colorado red-backed mouse (*Evotomys gapperi galei* Merriam[1]), and the Gale wood-rat (*Neotoma fallax* Merriam[2]). The following from a letter written by Captain Bendire to Mr. Gale on December 27, 1887, is of interest:

The skins I carried over to Mr. Merriam and saw him open them. From what you had said in your note I supposed there were but a few and not especially valuable, but

[1] C. Hart Merriam, "Description of a New *Evotomys* from Colorado," *North American Fauna*, No. 4, U. S. Agri. Dept., 1890, pp. 23, 24.

[2] C. Hart Merriam, "Abstract of a Study of the American Wood-rats, with Descriptions of Fourteen New Species and Subspecies of the Genus *Neotoma*," *Proc. Biol. Soc. of Wash.*, Vol. IX, 1894–95, pp. 117–128.

I wish you could have seen the Doctor's expression as he opened the different packages. He was perfectly delighted over the lot, says that some of the specimens are just what he has been wanting, that they prove certain of his conclusions, that some are different from anything he has seen so far, but what pleased him more than anything else is that stump-tailed rat with the naked tail. I never saw anyone so pleased. He will write you at length when he knows where to address you. The way the skins were made up surprised him considerably, for he said that he never got any as well prepared ones from an amateur before. "Why," he said, "I could not make them up better myself."

On the title-page of Bulletin No. 1 of The Colorado Biological Association, on the "Hymenoptera of Colorado," published in 1889, the list of officers of that early scientific society includes the name of Denis Gale as a member of the council, associated with H. W. Nash, Dr. J. M. Coulter, Dr. A. S. Packard, Dr. C. H. Merriam and D. W. Park. A letter just received from Mr. Horace G. Smith of Denver, contains the information that Mr. Gale was the last president of the association and was also a member of an earlier organization, the Colorado Ornithological Association (not the present organization of that name), which was broadened into the Colorado Biological Association. These facts connect him with the earliest efforts to establish co-operative relations among Rocky Mountain naturalists.

Mr. Gale's notes for the most part are of a prosaic but interesting character, consisting of the record of what he actually saw, such as the kinds of nesting sites occupied, the use and non-use of the same sites year after year, rebuilding of destroyed nests, refilling of rifled nests, the ease or difficulty with which the various species are flushed, their valor in defense of their young, etc. Occasionally, however, his poetic temperament and love for the beautiful in nature reveals itself in passionate and extravagant descriptions. The following account of the Audubon hermit thrush affords a good example of both styles, the first part being a matter-of-fact and detailed statement of his observations, while the closing portion is a picturesque eulogy of the species:

June 2. Saw the first of this species today, again on the 4th, a single bird. 12th, saw each day I was out two or three birds in every case singly. 20th, first nest with full complement fresh eggs at 9,000 feet. At 10,000 to 11,000 feet two or three weeks later as a rule. Eggs vary in color, in size and shape. They also differ often in the same set, from a beautiful, bright, tender, greenish blue of a clear, semi-transparent character to the dull shades of faint greenish indigo. Four eggs are generally the full set, laid consecutively, though three are sometimes the complement and in a single instance I have

found five eggs in a set. The nest sites vary from 30 inches to 15 feet from the ground, in the majority of cases within easy reach. With one exception deciduous[1] trees are chosen, mostly small ones. The nest is placed close to the stem with rare exceptions. As a rule very little attempt is made at concealment. In the immediate vicinity of some creek, small stream, spring or inwash is the chosen locality. The nests vary in bulk and density. They are quickly constructed. The materials used are those found near by the site and therefore from force of circumstances consist of mosses, rotten wood, grass and other plant stems, coarse plant stems or twigs for the outside and fine grasses, moss, horse hair and fine roots for the lining. The middle structure is manipulated in a damp state. One or two of the materials designated above may enter into the nest's construction to the almost entire exclusion of the others. There is a seeming carelessness in this species with reference to its nest and eggs. A careful watch and guard as with other birds is not theirs. Even when the young are hatched out they are not prompt in the defense of them. I have stood by the nest of the callow birds for half an hour before the female seemed to know it, but realizing danger, a proper alarm and daring was by no means wanting. From this want of vigilance no doubt the jays destroy many eggs and young. One if not both of the deserted nests sent[2] was I have no doubt the work of those pests, but whether before or after desertion I have no way of knowing. . . . . It stays in the vicinity of the home haunt until October, when it retraces its short flight as silently and unobtrusively as it came. It is not seen coming and going as is *swainsoni*, slightly up and down the gulches from and to the valley. *H. u. auduboni* is a very shy bird and always seen alone excepting the brief love-making period or when danger is threatening the well-fledged young and for a time after the young leave the nest. In the former instance they are very demonstrative and plucky. In the latter upon your approach to where a young bird is concealed the parents keep up a simple monotonous chirp. I have also seen them jointly chase a family of *Perisoreus c. capitalis* from the neighborhood of their nesting site. At all other times single birds only are seen, at most times with difficulty, for if they do not want to be seen they have the address to avoid the unpleasantness. If an interview of more than a glimpse is permitted it is in his interest and not in yours. Having demurely interviewed you, in two or three short flights he is lost to you. He has learned your secret and kept his own; this is perfectly clear and plain but not the less vexatious. The characteristic nesting habits of this species as I have discovered them are: At an elevation of a little over 10,000 feet, in a sylvan, park-like shelter just where the conditions permit of a liberal growth of timber verging upon the vertical line of dwarfishness,[3] restricted perhaps to a few acres—ofttimes so many yards embrace these attractions in miniature. Where the angular rocks, the decayed stumps with their prostrate trunks and the pigmy mounds and ridges of yet more aged monuments of decay all covered with mosses of liveliest green, mingled with dwarfed ferns, wild flowers and grasses of kindred tint, give to the whole groundwork a softness of effect and expression that is foiled by the angular trunks and limbs of the trees, at once restful to the eye and peaceful to the mind, altogether a scene of surpassing beauty—here dwells the hermit.

[1] Evidently a slip of the pen, as his notes show only one case of a nest in a deciduous tree—an aspen—and in another place he distinctly says that the aspen case was the only nest of the species he had ever found in anything but a coniferous tree.

[2] Sent to Washington.

[3] Evidently a reference to timber-line with its dwarfed trees.

To note his glidings over this rich carpet of green, making his full stops and his half stops in length and duration, suggests his punctuating a sermon upon the harmony of the surroundings and loveliness. He acts no folly, thinks no evil, speaks no mischief. Wherefore should he be distrustful of harm to his home and brood? At present his mate performs her quiet function in a charming nest of moss and grasses secured by a few twigs in a small balsam hard by, which the genial warmth of July is forcing to infant maturity its young shoots, and the parent stem to a prodigality of perfume. Here sits our female hermit in patient devotion, sheltered from the rough winds but open to enjoy to the fullest the cool, soft, sighing breath of summer. Here her cheek is crimsoned by the matin ray, with languishing pleasure she marks its midday travel and receives the gilding of its vesper kiss. Within easy wing of her present charge are relics of previous summers which call up past thoughts of endearing labors. Within softening distance bubbles the mountain stream, the avenue by which the snows of yesterday upon the neighboring peaks in liquid haste reach here to temper meridian fervor. Everything is music, therefore her mate is silent. Birds of poetic tastes and habits, fast friends to solitude, fit ministers to share in sweet solitude's silent adoration!

The writer, in analyzing Mr. Gale's notes, was sometimes forced to the conclusion that he had indulged in broad generalizations from limited data, and in one or two instances he seems to have allowed imagination of what was probably true to supplant deduction from the facts actually observed; but the facts themselves were usually definitely stated separately from his interpretation thereof, so that the reader of the notes may form his own conclusions. The notebooks, six in number, beginning with May 20, 1883, contain internal evidence of at least two or three years' prior observations in the region, perhaps beginning with his acquisition of the mining interests in 1881, but of such prior observations either he kept no notes or they have not come to light. His notes are written in a fine, cramped, old-fashioned hand, often difficult to read, many words being legible only under a lens of low power. These notebooks, together with his fine collection of nests and eggs, were acquired by the University of Colorado as part of the "Guggenheim Biological Collection," purchased with funds generously furnished by Hon. Simon Guggenheim, of Denver. The notes have been transcribed by the writer of this sketch, making 305 typewritten pages of letter-head size, annotated, indexed, substantially bound, and placed in the University Library so that the information therein is available to ornithologists visiting the University. The collection includes fine series of eggs and nests of many species, beautifully prepared, and the work of arranging

them so that they may be easily examined by students of oölogy, without handling them, and yet not exposed to the light, with full data in sight for each set, will be pushed to completion as rapidly as possible.

PAPERS BASED WHOLLY OR IN PART ON DENIS GALE'S NOTES AND SPECIMENS

By Capt. Chas. E. Bendire

"Notes on the Habits, Nests and Eggs of the Genus *Sphyrapicus*," *The Auk*, Vol. V, July, 1888, pp. 225–240. Quotes Gale as to *S. nuchalis* and *S. thyroideus*.

"A Peculiar Nest of *Cinclus mexicanus*," *The Auk*, Vol. VI, January, 1889, p. 75. Describes a roofless nest of *C. m. unicolor* found by Mr. Gale under a bridge on North Boulder Creek and referred to in Gale's notes.

"*Picicorvus columbianus* (Wils.), Clarke's Nutcracker. Its Nest and Eggs, etc.," *The Auk*, Vol. VI, July, 1889, pp. 226–236. Describes nest and eggs found by Mr. Gale, with five pages of Gale's notes, followed by a general account of what was then known of the habits of the species.

"Description of the Nest and Eggs of *Megascops asio maxwelliæ*, the Rocky Mountain Screech Owl," *The Auk*, Vol. VI, October, 1889, pp. 298–302. Includes two pages of Gale's notes.

"*Megascops asio maxwelliæ*," *The Auk*, Vol. VII, January, 1890, p. 91. Describes three pellets collected by Mr. Gale, one containing crayfish, another containing crayfish and beetles, and the other containing crayfish and a meadow mouse.

"A Second Nest of *Picicorvus columbianus* Taken in Colorado," *The Auk*, Vol. VII, January, 1890, p. 92. Records the second nest collected by Gale.

By Junius Henderson

"Destruction of Herons by a Hail-Storm," *The Condor*, Vol. IX, Sept. Oct., 1907, p. 162. Incidentally mentions destruction of nests of same colony by wind-storm many years before, noted by Gale.

"Nesting of Cross-Bills in Colorado," *The Auk*, Vol. XXIV, Oct., 1907, pp. 440–42. Consists mostly of quotations from Gale's notes.

"Colorado Notes," *The Condor*, Vol. IX, Nov.–Dec., 1907, p. 198. Among other items, records *Syrnium varium* from Boulder County on Gale's authority; second record for Colorado.

"The American Dipper in Colorado," *Bird Lore*, Vol. IX, Nov.–Dec,. 1907. Chiefly a transcript of Gale's interesting notes.

SOME BEES IN THE MUSEUM OF COMPARATIVE ZOÖLOGY, HARVARD UNIVERSITY

By T. D. A. Cockerell

When recently at Cambridge, I was permitted, through the kindness of Mr. Samuel Henshaw, to examine the type specimens of bees in the Museum of Comparative Zoölogy. The notes now offered relate to species described by Dr. A. S. Packard and Mr. E. T. Cresson. The species of Packard were published long ago (1867 and 1869), and have remained unknown, for the most part, to modern apidologists. The specimens are the true and only types, and include all the species of bees described by Packard. The Cressonian species are mostly from the Texan collections, forming the subject of the "Hymenoptera Texana" (1872). These Texan types, after description, were divided among several collections, and are to be found at the Philadelphia Academy, the National Museum at Washington, the Museum of Comparative Zoölogy, and also a set evidently from the same source in the British Museum. In some cases it is not quite clear which should be considered the true types, supposing the specimens not to agree with one another. Cresson distinctly states, however, that the Dallas County specimens, obtained by J. Boll, are in the Museum of Comparative Zoölogy.

Melipona pictifrons (Packard)

Anthidium pictifrons Packard, *Rept. Peabody Acad.*, 1869, p. 59.

Collected by Orton on the Napo River, Ecuador. This is a typical *Melipona;* about 13 mm. long; scutellum dark; hind margins of abdominal segments with white marks laterally, representing vestiges of white (tegumentary) bands; on the first segment the band is more developed, but very narrow. Tegulae dull testaceous; flagellum pale ferruginous beneath; scape cream-colored beneath; hair on inner side of hind basitarsus orange. The face-markings are reddish cream-color, and consist of a triangular supraclypeal mark; a median longitudinal bar, broadening like the head of a nail at each end, on the clypeus; a triangle occupying each lower corner of clypeus, touching the lower lateral extensions of the longitudinal bar; and triangular lateral marks, which send a narrow, almost linear, process up the orbital margin. Wings strongly yellowish-reddish. Another species of *Melipona* was taken by Orton between Quito and Napo, and is labeled with a manuscript name (as an *Anthidium*) by Packard. It has the hind margins of the abdominal segments white, the scutellum light translucent yellow, and the clypeus with

a longitudinal pale reddish line. I do not find that this was published; it differs from all the species known to me, and is probably new.

Trigona mellicolor Packard

A small species; head and thorax honey color; head large, broader than thorax; mandibles not dentate; metathorax darkened, its base black; wings hyaline, nervures pale honey color; legs honey color. Abdomen missing in the unique type.

The similarly colored *T. mellea* Smith has toothed mandibles.

Anthophora pilifrons Packard

♀. A species of ordinary size, the face with dense white hair, the vertex with much black, the thorax above with black and pale fulvous mixed, but on hind part of scutellum dense and entirely rather bright fulvous. First recurrent nervure reaching second submarginal cell in middle. Legs dark red; outer side of hind tibia and basitarsus with much coarse black hair. Abdomen with dense pale fulvous hair-bands. Apical plate very narrow.

Centris conica (Packard)

Anthophora conica Packard, *Rept. Peabody Acad.*, 1869, p. 57.

♀. This is a genuine *Centris*, of the subgenus *Trachina*. The face-marks are of the same type as those of *C. flavifrons* (Fabr.), but the lateral marks are narrower and longer, and the transverse bar on the clypeus is more elevated in the middle, forming, with the upright mark, a sort of reversed Y. Labrum cream-color; eyes large, prominent, green; thorax above with dense rufo-fulvous hair, pleura with paler hair; legs red, the large scopa of hind legs orange-fulvous; abdomen red; the second and third segments with the posterior middle, narrowing laterally, darker and a little metallic; segments 4 and 5 with orange-fulvous hair, and their tegument pale, except that 4 is dark in basal middle.

Centris quadrimaculata Packard

♀. Nearly 25 mm. long; face with four subtriangular cream-colored marks, two of them on the clypeus; middle of clypeus impunctate; upper part of cheeks very shiny; hair of thorax above chocolate-color, dense, moss-like; scopa of hind legs fulvous; wings deep ferruginous; abdomen clear red, without bands.

Friese suggests that this may be the female of *C. personata* Smith, but it is too large.

Centris braccata Packard

♀. A large black species, about 30 mm. long; no light marks on face; basal half of first abdominal segment ferruginous; mandibles with a yellow subapical band; clypeus deep ferruginous, with a smooth median band, which is faintly keeled in the middle; posterior orbital margins very narrowly ferruginous; hair of thorax above dense, brown-black; wings very dark violaceous; abdomen without bands; scopa of hind legs brown-black. Close to *C. atra* Friese, but larger.

Eulæma bombiformis (Packard)

Euglossa bombiformis Packard, *Rept. Peabody Acad.*, 1869, p. 57.

Very large and robust, about 30 mm. long; mouth parts very large; head and thorax black, with short dark chocolate-colored hair; eyes green; clypeus with a strong median longitudinal keel; a ridge across front as in *E. dimidiata;* scutellum as in *dimidiata;* wings with basal part fuscous, beyond that pale reddish, the apical margin broadly hya-

line; abdomen with brilliant purple and green colors, and bright fulvous hair forming bands on apical margins of segments and covering apex. Second recurrent nervure joining third transverso-cubital; basal nervure going a little basad of transverso-medial.

Exceedingly close to *E. dimidiata* (Fabr.), but I think a valid species.

Tetralonia honesta (Cresson)

"Melissodes honesta Cress., type."

♂. Flagellum all black; sides of clypeal yellow obtusely notched; labrum black; mandibles with no light spot; hair of cheeks copious and white, of thorax above quite bright fulvous; mesothorax densely punctured and dull, more sparsely and shining in middle; abdomen with a broadly interrupted white hair-band on second segment, and entire ones on the following; tarsi slender, but otherwise normal; third antennal joint much longer than broad.

Melecta interrupta Cresson

"Melecta interrupta Cress., type. Dallas."

♂. Pubescence of abdominal bands very pale yellowish; legs dark ferruginous; scutellum mammiform; apex of abdomen emarginate; flagellum very thick.

Osmia lignivora Packard

♀. "From cells in maple." Robust, about 13 mm. long, head large; hair of vertex and thorax above light silky yellowish, with no black intermixed; *of face below antennæ dark chocolate;* a very large transverse ridge or thickening just above apical margin of clypeus; mandibles with two strong apical teeth, and a long inner cutting edge, their outer surface with fulvous hair; vertex dark bluish, front green; legs dark ferruginous, the femora quite red; no metallic color on legs; hair of legs shading from fuscous to ferruginous; *ventral scopa largely reddish,* the hair more dark fuscous basally, more red apically; abdomen dark purplish, hind margins of segments more or less (very narrowly) rufescent.

A very striking species, suggestive of some of the Central Asian forms.

Osmia chalybea Smith

"Osmia texana Cress., n. sp., 648."

This is a *female,* whereas *O. texana* was based exclusively on two *males.* Cresson records from Texas a single ♀ *O. chalybea,* collected by Belfrage; I suppose this to be the specimen examined by me, since that certainly appears to be *chalybea.* Its principal characters are as follows:

Bright steel blue, of fair size, with white pubescence, which forms narrow fine bands on lateral hind margins of first three abdominal segments. Scopa black, but hair on lateral margins of abdomen white. Vertex broad, with strong large punctures. Wings quite dusky. Legs not at all metallic, hair of tarsi mainly fulvous. Mandibles broad, with two sharp apical teeth, and a rudimentary third one; outer side, parallel with the cutting edge, with a band of conspicuous fulvous hair. Middle of apical margin of clypeus with a pair of strong nodules, and between them a little keel.

Osmia subfasciata Cresson

"Osmia subfasciata Cress., n. sp., 649."

♀. This must surely be a genuine type, although it has the abdominal scopa shining

white, and the anterior and middle femora strongly tinged with metallic blue; whereas Cresson says "scopa pale ochraceous" and "legs black." It is a little bright steel blue species, about 8 mm. long, with more or less complete narrow pure white bands on the abdomen. Mandibles 3-dentate; hair of face all white; a pair of little orange tufts below anterior margin of clypeus; hair on inner side of tarsi light yellow.

Osmia densa Cresson

"**Osmia densa** Cress. MS., n. sp., Georgetown, July 8."

♀. About 12 mm. long, with the head thrust forward. The specimen is evidently from a spider's web, and curiously, has lost all its ventral scopa, except some black hairs (carrying pollen) on extreme sides. Much coarse black hair on face with finer white hair intermixed; hair of pleura white, of scutellum *all* light, but dark hairs intermixed on mesothorax, some quite at hind border; legs not at all metallic; wings yellowish; abdomen with strong purple-blue tints, hind margins of segments not at all pallid.

This is a genuine *densa*, but not the type; the latter was from Pike's Peak.

Halictus albitarsis Cresson

"**Halictus albitarsis** Cress., type. Dallas."

♂. About 6 mm. long; with head extended. Wings milky whitish, iridescent, with pale amber-colored stigma and nervures, the stigma quite brightly colored; antennæ long, the flagellum bright ferruginous beneath; tarsi light yellow, with the apical joint more or less ferruginous; knees light; head and thorax olive-green, metathorax bluer; head rather long; labrum yellow except at sides; area of metathorax with longitudinal plicæ, its apical surface not sharp-edged laterally; abdomen dark rufopiceous.

The original description was based on twenty-six specimens, and probably included more than one species. The color of the antennæ and abdomen, as described, do not agree well with the specimen examined.

Halictus rimosiceps Packard

♀. Quito, Ecuador. Nearly 10 mm. long; head and thorax dark olive green, thorax above dull and granular; metathorax with fine dark blue tints. Abdomen rufopiceous, slightly purplish, the fimbria fuscous. Legs dark, refescent. Wings hyaline, stigma and nervures dull reddish. Second submarginal cell approximately square, receiving first recurrent nervure just before its end; *area of metathorax dull and granular, not at all ridged or grooved;* hair of face and cheeks white, of vertex and front largely black; hair of thorax mixed black and light; eyes normal, little emarginate; *abdomen without bands*, and second segment not in the least vibrissate. Hind spur with two very large blunt spines, and a rudiment of a third.

Augochlora nigroænea Packard

♀. Quito to Napo River, Ecuador. About 9 mm. long, belongs to group Sericei, not at all vibrissate, and the hind spur pectinate with a few large teeth. Face bluish-green, dullish and granular, with sparse punctures; eyes strongly emarginate; mesothorax dull green, blackish in middle; scutellum black; area of metathorax black, concave, with very fine longitudinal striation; the metathorax outside area is green, contrasting; pleura black; wings dusky, the costal region broadly suffusedly darker; second submarginal cell receiving first recurrent nervure near its end; abdomen black, with the hind margins

of segments reddish, and their bases brilliant green; legs rufopiceous, not metallic. A very distinct species.

Augochlora fuscipes Packard

♀. Between Quito and Napo. About 9 mm. long; not at all vibrissate; the legs are so placed that the hind spur cannot be seen. Face bright green, front and vertex black; mesothorax and scutella black; pleura greenish; area of metathorax broad, flat, granular, bright green; abdomen very dark purplish, green at sides; second segment narrowly green right across at base; wings strongly reddish; first recurrent nervure joins second submarginal cell at its apex; legs ferruginous.

THE GENUS CRATAEGUS IN COLORADO

By T. D. A. Cockerell

A few years ago the writer began a study of the thorns growing about Boulder, and sent some material to Dr. Sargent, the well-known authority on this genus. It was hoped that the local forms would be readily identified, but numerous difficulties presented themselves. Not only were the several kinds very closely allied, but the existing descriptions—which were quite numerous enough to cover all the known forms—proved to be seriously inadequate. The best of them, by Professor Aven Nelson, were unfortunately the latest to be published, and there was little doubt that the plants should be known by the earlier designations of Britton[1] and Ashe.[2] Dr. Rydberg's account of *Crataegus*, in his excellent *Flora of Colorado*, did not clear up the difficulties, and unfortunately contained one or two serious errors.

No revision of the Colorado Crataegi is to be thought of at present, I offer instead merely a summary of the characters given in the original descriptions of the six supposed species founded on specimens from the foothills of the front range of northern Colorado, and a list of the species known from the state, as at present understood. The characters given in the descriptions are presented as originally written, so that the reader may have before him all the information provided by the original authors. It is hoped that students throughout the state will examine the Crataegi of their vicinity in the light of these descriptions, and that with their co-operation it may be possible eventually to put the subject on a sound basis. In the study of these plants, it is especially important to secure flowers and fruit from the same trees, which should be marked to prevent mistakes. It is also very important to note the color of the anthers in fresh flowers.

Mr. Eggleston of the New York Botanical Garden has examined all Nelson's types, as well as that of *occidentalis* Britton, and has kindly given me some important information. He has also found some reliable

[1] *Bull. N. Y. Bot. Gard.*, I, 448 (March 30, 1900).

[2] *Bull.* 175, *N. C. Agric. Exp. Sta.*, 110, 113 (Aug., 1900).

characters for the separation of some of the species in the nutlets, particulars of which will be given in Dr. Britton's forthcoming work on trees.

The Colorado species are as follows:

1. *C. rivularis* Nuttall=*wheeleri* Rydberg, *Flora of Colorado* (not of Nelson). Mr. Eggleston tells me that Rydberg was misled by receiving this from Wheeler as *wheeleri*.
2. *C. saligna* Greene. Syn. *wheeleri* A. Nels., *fide* Eggleston.
3. *C. erythropoda* Ashe. Syn. *cerronis* A. Nels. I had made this synonymy out from the descriptions, and Eggleston agrees.[1] It is a species with the leaves conspicuously shiny above.
4. *C. colorado* Ashe. I believed *coloradensis* A. Nels. to be the same, but it has smooth twigs, and must go rather with the next species.
5. *C. occidentalis* Britton. Mr. Eggleston agrees that my *occidentalis* is correctly named but says that the *occidentalis* of Rydberg's *Flora of Colorado* was primarily based (as to the characters) on the Nebraska plant; which although cited by Britton as *occidentalis*, is really a different species.
6. *C. chrysocarpa* Ashe. I have not recognized this.

Mr. Eggleston, working from herbarium material had united *occidentalis* with *colorado* and *coloradensis*. There are, however, two quite distinct species, growing mixed together at Boulder. There is no question about the identity of *colorado;* but it is just possible that I have not correctly determined *occidentalis*, the latter having been based on a flowering specimen affording very few diagnostic characters—the color of the anthers being lost, and the leaves of the two plants being indistinguishable. The following comparative table is derived from a couple of trees, standing a few feet apart, which have been examined at intervals for two years.

C. colorado	*C. occidentalis*
Anthers cream-color (10 stamens, 2–3 stigmas).	Anthers pink.
Bark rougher (perhaps not a constant character).	Bark smoother.
Young twigs thinly but evidently lanulose.	Young twigs strictly glabrous.
Flowers earlier.	Flowers later.
In August with much more fruit; this brighter red.	
On October 2, foliage dark green.	On October 2, foliage becoming bright reddish-orange.

The following fossil species of *Crataegus* have been found in Colorado:

7. *C. lesquereuxi* Ckll. 1906 (*acerifolia* Lx., not Moench). Miocene; Florissant.

[1] Nevertheless, there is a discrepancy in the color of the fruit, not yet explained.

8. *C. newberryi* Ckll. (*flavescens* Newberry, 1883, not Bosc or Steud.). Reported from the Miocene of Florissant.
9. *C. antiqua* Heer. Denver group, Golden.
10. *C. betulæfolia* Lx. Denver group, Golden.
11. *C. engelhardti* Lx. Denver group, Golden.
12. *C. holmesii* Lx. Denver group, Silver Cliff.
13. *C. myricoides* Lx. Denver group, Golden.

Original Descriptions

Size and Form

Occidentalis—shrub or small tree, sometimes 6–7 m. high.

Chrysocarpa—small tree with narrow crown and ascending branches.

Colorado—small tree with spreading or ascending branches.

Erythropoda—small tree.

Cerronis—tree-like, 2–5 m. high, rather widely branched; trunk short and stout, with rough bark.

Coloradensis—a low well-branched tree, but rather more open than the other sorts, about 10–12 feet tall, isolated specimens being very well rounded and symmetrical (Andrews). Bark of the branches gray, irregularly furrowed and checked, with few rather large lenticels.

Twigs

Occidentalis—(no mention).

Chrysocarpa—twigs of the season somewhat villous when young, becoming glabrous; varnished brown, or reddish the second year.

Colorado—twigs of the season villous, stout, 3–5 mm. thick, purple-brown.

Erythropoda—glabrous, bright purple or brown-purple.

Cerronis—young twigs brown, passing into the gray of the older ones; lenticels small, nearly white.

Coloradensis—stoutish, glossy-brown (some of the young foliar twigs slender and green). Mr. Eggleston has examined the type, and reports that the twigs are smooth.

Thorns

Occidentalis—slender, about 3 cm. long.

Chrysocarpa—(no mention).

Colorado—numerous, stout, dark purple; 5–7 cm. long.

Erythropoda—twigs sparingly armed with slender purple thorns 2–3 cm. long.

Cerronis—numerous, short (2–3 cm.), stout and thick for the length, straight, rarely a little deflexed, very dark morocco-red, with small light-covered lenticels.

Coloradensis—rather few, often nearly wanting on some branches, glossy-brown, very variable as to length (3–5 cm.), straight or slightly decurved.

Leaves (blades)

Occidentalis—oval or slightly obovate, *irregularly serrate and sometimes slightly lobed*, mostly obtuse at the apex, and narrowed or subcuneate at the base, 4–7 cm. long, 3 or 4 cm. wide, slender-petioled, pubescent beneath, at least on the veins.

Chrysocarpa—when mature perfectly glabrous, ovate, deltoid or rhombic in outline, obtuse at the apex, obtuse or truncate at the base, very finely and sharply glandular serrate, 7–9 *lobed*, firm in texture, dark green above, much paler beneath.

Colorado—ovate or nearly orbicular, 4–7 cm. long, 3–6 cm. wide, *sharply serrate, or above doubly serrate or 3–7 lobed,* bright green, glabrous.

Erythropoda—bright green, glabrous, 3–7 cm. long, 2–5 cm. broad, ovate or obovate in outline, obtuse or acute at apex, obtuse or acute at the base, which is decurrent on the petiole; *rather obtusely serrate, sometimes with 3–7 shallow lobes.*

Cerronis—broadly elliptic-ovate, 3–5 cm. long, 2–3 cm. broad, *coarsely and serrately few-toothed, the teeth with finer gland-tipped acute serrations,* acute or acuminate at apex, the abruptly cuneate base entire or remotely serrulate, light green and perfectly glabrous below, sparsely ciliate-pubescent above, especially on the veins.

Coloradensis—4–5 cm. long, mostly broadly oval to orbicular in outline, sometimes a little narrower, or the upper half broadly triangular-acute; the base rounded or somewhat cuneate, entire or minutely serrate; *the upper half incisely and coarsely toothed, with finer serrations on the teeth,* which are slightly calloused but not glandular; scatteringly ciliate-pubescent above, nearly glabrous beneath except on the midrib and primary veins which are noticeably ciliate-pubescent or hirsute, even at maturity; nearly full size when the flowers open.

Petioles

Occidentalis—slender.

Chrysocarpa—at first pubescent, at length nearly glabrous, slender, 1–2 cm. long, narrowly winged, roughened with a few dark brown glands.

Colorado—1–1½ cm. long, grooved on the upper surfaces, villous.

Erythropoda—half to 1½ cm. long, winged above, generally purplish.

Cerronis—slender, without glands, channeled above, 5–20 mm. long.

Coloradensis—moderately stout, short, rarely more than ¼ or ⅓ as long as the blade.

Inflorescence

Occidentalis—corymbs several-flowered.

Chrysocarpa—corymbs compound, the branches more or less villous.

Colorado—corymbs many, 10–20 flowered, compound, villous, as well as the conical calyx.

Erythropoda—glabrous, compound, 3–7 cm. wide.

Cerronis—the paniculate corymb 5–10 flowered, congested in blossom but more open in fruit.

Coloradensis—corymb many-flowered (10–12), broad or flat-topped, the pedicels hirsute-pubescent, rather slender, 1–3 cm. long.

Flowers

Occidentalis—about 1½ cm. wide.

Chrysocarpa—(no mention).

Colorado—about 1.8 cm. wide.

Erythropoda—(no mention).

Cerronis—petals suborbicular, with shallow crenations, noticeably reticulate-veined, 6–8 mm. broad.

Coloradensis—petals orbicular, about 8 mm. diameter, crenately toothed.

Calyx

Occidentalis—(no mention).

Chrysocarpa—(no mention).

Colorado—conical, lobes serrulate.

Erythropoda—lobes slender, entire.

Cerronis—calyx-tube only 2–3 mm. long, shorter than its lobes; lobes ovate, with a broad gland-margined acumination.

Coloradensis—calyx-tube very short, hirsute, its narrow lobes cut into long slender nearly cylindrical gland-tipped teeth.

STAMENS AND STYLES

Occidentalis—(no mention).

Chrysocarpa—stamens 10, styles 3–4.

Colorado—stamens 10, equalling the 2–3 styles.

Erythropoda—(no mention).

Cerronis—stamens few (1–8, mostly 5–8); anthers large, purple, pistils 5.

Coloradensis—stamens 10, about 5 mm. long; styles stout, mostly 3, rarely 2 or 4.

FRUIT

Occidentalis—oval-globose, about 1 cm. long.

Chrysocarpa—very abundant, golden yellow, orange, or reddish, 8–9 mm. long, generally not quite so thick; nutlets 3–4.

Colorado—very abundant, at length glabrous, bright glossy red, 6–7 mm. thick; nutlets 2–3.

Erythropoda—glabrous, 7–8 mm. thick, orange, red, or red and orange.

Cerronis—nutlets 5. In *Proc. Biol. Soc. Wash.*, December, 1904, p. 176, it is stated that the fruit is black, mostly less than 1 cm. in diameter, the amount of pulp small; carpels usually dissimilar, some of them being laterally flattened. (The statement that the fruit is black applies only to dried specimens; in the fresh state it is red. Mr. D. M. Andrews tells me that when quite ripe it gets a dark purplish red, verging on chocolate.)

Coloradensis—mature fruit large, 10–13 mm. diameter, dark scarlet red, tipped with the persistent calyx-lobes and filaments, the pulp juicy and well-flavored, the 2–4 (mostly 3) nutlets rather large, slightly ridged on the back.

TYPE-LOCALITY

Occidentalis—Golden, collected by E. L. Greene. (The Nebraska specimens cited belong to another species; *fide* Eggleston.)

Chrysocarpa, colorado, erythropoda.—"foothills of the Cache la Poudre Mountains, at about 6,000 ft.," collected by Ashe, August 20, 1899.

Cerronis—Cerro Summit, Colorado, prox. 2,500 m., flowers June 7, fruit July 12, 1901, collected by Baker. Also cited from near Boulder, collected by Ramaley.

Coloradensis—Gregory Canyon, Boulder, collected by Andrews.

THE SILVA OF COLORADO

III. Woody Plants of Boulder County

By Francis Ramaley

Introduction.—This paper is intended as a preliminary report on the trees, shrubs and vines of Boulder County. It is hoped that the general discussion which follows, as well as the annotated list, may be useful to students, botanists or others interested in woody plants. Since the character of the flora is about the same all along the eastern foothill region in Colorado north of the Palmer Lake divide, most of the facts stated here will be of more general application than if Boulder County were a region apart.

Sources of material.—Collections for the University of Colorado herbarium were first made by Mr. J. I. McFarland in 1881.[1] In 1895 and 1896 Mr. F. Y. Moseley, at that time an assistant in the department of biology, collected some specimens at Long's Peak and other alpine and sub-alpine stations. In the summer of 1900 and from time to time since then the author has made collections in various parts of the county. Most of the Boulder County plants now in the herbarium are of these collections. During 1906 and 1907 the writer was assisted by Mr. W. W. Robbins, a graduate of the University. The larger part of the author's collections have been identified by Professor Aven Nelson of the University of Wyoming without whose accurate determinations the publication of this paper would be impossible at the present time. The valuable work of Dr. P. A. Rydberg[2] has been consulted constantly and specimens cited by him in Boulder County are noted in the following list, credit being given in each case. Dr. Robert T. Young, now of the University of North Dakota, but formerly a resident of Boulder, made collections in the county but I have not seen his plants.[3]

[1] Mr. McFarland was a member of the first graduating class of the University.

[2] *Flora of Colorado*, Bull. 100, Agr. Exp. Sta., Colo. Agr. Coll. 1906.

[3] Dr. Young has prepared a valuable paper on the "Forest Formations of Boulder County" just published in *Botanical Gazette*, Vol. XLIX, pp. 321–352. 1907.

Families and genera represented.—The 112 species of woody plants listed for the county are distributed in 29 families and 50 genera. Trees occur only in the following families: *Pinaceae, Juniperaceae, Salicaceae, Betulaceae, Ulmaceae, Pomaceae, Drupaceae, Aceraceae, Caprifoliaceae.* Families represented by 7 or more species of woody plants: *Pinaceae, Salicaceae, Grossulariaceae, Rosaceae, Pomaceae, Caprifoliaceae.* Other families have only a few species each. It is of interest to point out that no oaks occur in the county although they are abundant at Morrison, to the south, and some occur in North Park, to the north.

Other woody plants probably in the county.—This list is merely preliminary. More complete collections are necessary. Species should be looked for in the following genera: *Juniperus, Sabina, Salix, Ribes, Rosa, Amelanchier, Prunus, Amorpha, Robinia, Acer, Ceanothus Lepargyraea, Phyllodoce, Cornus, Sambucus* and *Symphoricarpos.*

Economic plants.—Trees used for lumber: *Pinus flexilis, Pinus scopulorum, Pinus murrayana, Picea engelmanni, Pseudotsuga mucronata.* Trees furnishing posts and rails or used for fuel, in addition to the above list: *Sabina scopulorum*, all of the species of *Populus* and some of the willows. Trees planted for shade or ornament: nearly all the *Pinaceae* and *Juniperaceae;* all the poplars or cottonwoods, but more often *Populus sargentii* and *Populus acuminata;* some of the willows, also box elder. Trees which are seldom planted but which might prove valuable for ornament: *Betula andrewsii, Betula fontinalis, Celtis reticulata, Crataegus* spp., *Acer glabrum.* Many of the native shrubs would be ornamental. Some of the following have been introduced to a slight degree but more might be used: *Berberis aquifolium, Edwinia americana, Ribes longiflorum, Dasiphora fruticosa, Holodiscus dumosus, Opulaster monogynus, Opulaster ramaleyi, Rubus deliciosus, Rubus parviflorus*, some of the species of *Amelanchier, Sorbus scopulina, Ceanothus velutinus, Lepargyraea canadensis, Cornus stolonifera, Apocynum androsemaefolium, Distegia involucrata, Sambucus microbotrys.*

Geography of Boulder County.—The accompanying map gives the important streams and mountains as well as the towns in the county. East of the "front ridge of foothills" noted on the map there is plains

SKETCH MAP OF BOULDER COUNTY

The smaller gulches or canyons near Boulder are numbered on the map as follows: 1. Sunshine Canyon; 2. Gregory Canyon; 3. Bluebell Canyon; 4. Pole Canyon; 5. Bear Canyon.

country, with an altitude of from 4,900 to 5,500 ft. To the west is a region of foothills, dissected plateaus and alpine peaks. The peaks vary in height from 12,500 ft. (Bald Mt.) to over 14,000 ft. (Long's Peak). The foot of the main range, or continental divide, is 10,000 to 10,500 feet in altitude and the lowest passes from 1,000 to 2,000 ft. higher. Boulder County is in north central Colorado, the city of Boulder being about 25 miles northwest of Denver.

Altitudinal distribution.—The limits of altitude printed in the systematic list are based not only on collections, but also on field notes taken at various times when no collections were made. It is believe that they are substantially correct. However, occasional plants of nearly every species may be found somewhat above or below the limits given. This is naturally the case since a number of edaphic factors may unite in places to overbalance the climatic factor of temperature which is the chief one introduced by altitude. It is worthy of note that most of the trees of the plains region ascend only to 6,000 or 6,500 ft.; a few of the trees and a number of shrubs reach 8,000 or 9,000 ft. Above 9,000 ft. there is considerable change in the flora and at an altitude of 10,000 ft. practically all of the woody plants are true mountain species. If, then, one wishes to go from the plains at Boulder (or Denver) to where there is an entirely different flora it will be necessary to reach an altitude of about 10,000 ft. The chart on page 52 shows the altitudinal distribution for a number of our most characteristic and easily identified species of woody plants.

Zones of plant life.—The following zones of plant life in Boulder County may be distinguished.[1] (1) *Plains zone*, altitude up to 5,800 ft.—a grassland formation; trees and shrubs only along streams and on rock ridges. (2) *Foothill zone*, altitude 5,800 to 8,000 ft.—generally a rather open forest of rock pine on hillsides with a mixture of Douglas spruce on north slopes and some deciduous trees in the canyons. (3) *Montane zone*, altitude 8,000 to 10,000 ft.—closer forest of lodgepole pine with admixtures of rock pine and limber pine at various places; Engelmann spruce in the higher parts. (4) *Sub-alpine zone*, altitude 10,000 to 11,500 ft.—characterized by forests of Engelmann spruce

[1] See a note on this subject by the present writer in *Science*, Vol. XXVI, p. 642, 1907.

with limber pine and balsam fir as secondary species. *Vaccinium* is usually abundant on the forest floor. A considerable amount of grassland occurs as mountain meadows in the upper part of this zone. "Wind timber" runs up in tongues to various altitudes and there are small patches of such scrub isolated from the main part below. Numerous small lakes and bogs occur along stream courses. (5) *Alpine zone*, altitude 11,500 to 14,000. This is a grassland and rock-desert zone. Dwarf willows occur, often in large patches, but there are no other woody plants.

List of Species of Woody Plants

PINACEAE, Pine Family

Pinus flexilis James. Limber Pine, White Pine

Usually a rather small tree but reaching considerable size among Engelmann spruces at about 10,000 ft. At lower altitudes it occurs chiefly in wind-swept stations. Easily distinguished from other pines of this county by its large, smooth cones and its short leaves in bundles of five. In exposed places it is much contorted, the trunk sometimes prostrate.

Altitude: 7,500 to 11,000 ft. Collections: Eldora; Sugarloaf; Ward. Isolated specimens of this pine probably occur as low as 6,500 ft. where much exposed to wind.

Pinus murrayana "Oreg. Com." Lodgepole Pine

A slender medium-sized tree forming dense, pure forests at altitudes of about 8,000 or 9,000 ft. It also occurs mixed with the rock pine and limber pine in some places. Leaves are in bundles of two, the cones small and numerous. Used for fuel, timber, posts and railroad ties.

Altitude: 6,500 to 10,500 ft. Collections: Allenspark; Eldora; Pine Glade School.

Pinus scopulorum (Englem.) Lemmon. Rock Pine

A handsome spreading tree, the largest of our native conifers. This is the only pine on the mesas and lower foothills in the county. Formerly much used for lumber but the supply in Boulder county now nearly exhausted. The lumber is known locally as "native" and "black jack." Easily distinguished by its long leaves, 1 dm. or more in length. The leaves are in bundles of two or three.

Altitude: 5,000 to 9,000 ft. Collections: Eldora; Sugarloaf; Bluebell Canyon; head of Gregory Canyon, altitude 7,400 ft.

Picea parryana (Andree) Sarg. Blue Spruce, Silver Spruce

A handsome, ornamental tree sometimes with silvery bloom especially on the leaves at tips of branches. It should be noted, however, that the Engelmann spruce and the Douglas spruce frequently are "blue" also. Moist situations along streams throughout the county within its altitudinal limit. The blue spruce never forms forests but occurs in fringes along streams or sometimes in small groves. Much planted for ornament.

Altitude: 6,500 to 10,500 ft. Collections: Fourth of July Mine; South Boulder Canyon, altitude, 6,800 ft.

Picea engelmanni (Parry) Engelm. ENGELMANN SPRUCE

A handsome conical tree frequently forming pure forests at about 10,000 to 11,000 ft. Common everywhere in the higher altitudes throughout the county. It forms most of the "wind timber" at timber line. Used for timber and railroad ties. The lumber is known locally as "white spruce."

Altitude: 8,500 to 11,500 ft. Collections: Eldora, Silver Lake.

Pseudotsuga mucronata (Raf.) Sudw. DOUGLAS SPRUCE

A handsome broad-based conical tree of moist gulches and north slopes. It has a less compact and more feathery appearance than the true spruces. The wood is valuable

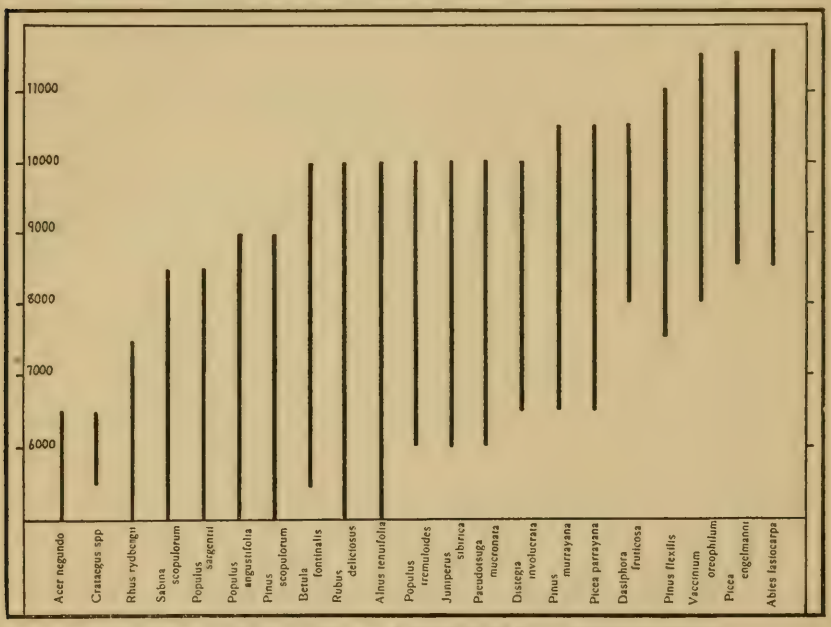


CHART ILLUSTRATING ALTITUDINAL DISTRIBUTION

The figures at the left indicate altitude above sea level expressed in feet. The lowest point in Boulder County is about 4,900 ft. Probably most of the species which are indicated as extending down to 5,000 ft. really reach to the lowest point in the county. The species selected for the chart are those most easily recognized without attention to minute characters.

for lumber and when used locally is known as "red spruce." Young trees are cut for decoration at Christmas time.

Altitude 6,000 to 10,000 ft. Collections: South Boulder Canyon; Gregory Canyon; Sugarloaf Mountain; Eldora.

Abies lasiocarpa (Hook.) Nutt. BALSAM FIR

Usually a small tree, but sometimes 3 to 4 dm. in diameter. In the lower parts of

its range this tree grows with limber pine and at higher altitudes with Engelmann spruce. Scattered trees are found to the upper limit of wind-blown timber on all the peaks. Seldom used for lumber; the wood is weak and brittle.

Altitude: 8,000 to 11,500 ft. Collections: Eldora; Ward; foot of Mt. Audubon.

JUNIPERACEAE, Juniper Family

Juniperus sibirica Burgsd. Juniper

A prostrate spreading shrub with sharp-pointed leaves. Dry situations on mesas and foothills to the base of the main range.

Altitude: 6,000 to 10,000 ft. Collections: South Boulder Canyon, 6,800 ft.; above Magnolia; Sugarloaf; Eldora; foot of Long's Peak; Gresham; "mountains between Sunshine and Ward" (Rydberg).

Sabina scopulorum (Sarg.) Rydb. Cedar, Red Cedar

A small conical tree, or in wind-swept places much distorted. Usually in exposed situations on hills and ridges; formerly used for fence posts, but the supply now exhausted.

Altitude: 5,000 to 8,500 ft. Collections: Bluebell Canyon; South Boulder Canyon 6,800 ft.; above Magnolia; Sugarloaf.

SMILACEAE, Smilax Family

Nemexia lasioneuron (Hook.) Rydb. Smilax, Carrion Flower

A low, trailing plant of shady situations growing under trees and bushes.

Altitude: 5,000 to 6,500 ft. Collections: mouth of Boulder Canyon; mouth of Gregory Canyon.

SALICACEAE, Willow Family

Populus acuminata Rydb. Lanceleaf Cottonwood

A medium-sized tree of somewhat symmetrical form rather rare in Boulder County except where planted. Along streams.

Altitude: 4,900 to 6,000 ft. Collections: gulch one mile south of Chautauqua; Valmont; cultivated at Boulder.

Populus angustifolia James. Narrowleaf Cottonwood

A tree of open, unsymmetrical form growing along streams. Very common.

Altitude: 5,000 to 9,000 ft. Collections: 17th Street bridge at Boulder; Boulder; South Boulder Canyon; Valmont; mouth of Gregory Canyon; "Boulder" (Rydberg).

Populus balsamifera Linn. Balm of Gilead, Balsam Poplar

A medium sized tree of gulches and along streams.

Altitude: 8,000 to 10,000 ft. Collections: Fouth of July Mine; Eldora; Allenspark.

Populus sargentii Dode. Common Western Cottonwood

This is *Populus occidentalis* of Rydberg's *Flora* and *P. angulata* of Coulter's *Manual*. Common along streams in the plains region and occasional in the mountains. Much planted for shade.

Altitude: 4,900 to 8,500 ft. Collections: Valmont; Boulder Creek; Boulder; mouth of Gregory Canyon; "Eldora to Baltimore" (Rydberg).

Populus tremuloides Michx. Quaking Aspen

A small tree of moist slopes and gulches forming characteristic groves.

Altitude: 6,000 to 10,000 ft. Collections: Gregory Canyon; South Boulder Canyon; Sugarloaf Mountain.

Salix amygdaloides Anders. PEACH WILLOW.

This is the commonest tree willow of the county. Along streams in the plains region and lower foothills.

Altitude: 4,900 to 7,000 ft. Collections: Valmont; Boulder; University campus; mouth of St. Vrain Canyon; "near Boulder" (Rydberg).

Salix bebbiana Sarg. BEBB'S WILLOW

A bushy tree at lower stations and low shrub in high elevations. Along streams and margins of lakes.

Altitude: 4,900 to 10,000 ft. Collections: Boulder; near Boulder; South Boulder Creek; Bear Canyon; "Boulder" (Rydberg).

Salix brachycarpa Nutt. DWARF WILLOW

Altitude: 7,000 to 11,000 ft. Collection: Silver Lake.

Salix chlorophylla Anders. WILLOW

Altitude: 8,000 to 10,500 ft. Collection: near Fourth of July Mine.

Salix exigua Nutt. NARROWLEAF WILLOW

A common willow fringing streams.

Altitude: 5,000 to 9,000 ft. Collections: Marshall; Valmont; Boulder; South Boulder Canyon; near junction of Fourmile and Boulder Creek.

Salix fendleriana Anders. WILLOW

Altitude: 6,000 to 9,000 ft. Collection: South Boulder Canyon.

Salix glaucops Anders. WILLOW

Altitude: 7,000 to 12,000. Collections: Eldora; Long's Peak; "south of Ward" (Rydberg).

Salix luteosericea Rydb. SILKY WILLOW

Altitude: 5,000 to 7,000 ft. Collections: South Boulder Canyon, 6,800, ft.; "near Boulder" (Rydberg).

Salix nuttallii Sarg. BLACK WILLOW

A slender tree with handsome, dark, shining leaves. Along streams and sometimes scattered in moist places through coniferous forests.

Altitude: 7,000 to 10,000 ft. Collections: Sugarloaf Mountain; Bluebird Mine; Spencer Mountain at Eldora; "Eldora to Baltimore" (Rydberg).

Salix perrostrata Rydb. WILLOW

Distribution in Boulder County not known. Collections: "Boulder" (Rydberg).

Salix pseudolapponicum Seem. DWARF WILLOW

Altitude: 10,000 to 13,000 ft. Collections: Fourth of July Mine; "Eldora to Baltimore" (Rydberg).

Salix saximontana Rydb. DWARF WILLOW

Altitude: 9,000 to 14,000 ft. Collections: Long's Peak; "Arapahoe Peak" (Rydberg).

Salix wolfii Bebb. WILLOW

Altitude: 8,000 to 10,500 ft. Collections: "Eldora to Baltimore" (Rydberg).

BETULACEAE, Birch Family

Alnus tenuifolia Nutt. Alder

A small tree along streams throughout the plains and foothill regions.

Altitude: 5,000 to 10,000 ft. Collections: East of Boulder; St. Vrain Creek; Sunshine Canyon; South Boulder Canyon; Allenspark; Eldora; west of Ward; "lower Boulder Canyon" (Rydberg).

Betula andrewsii Aven Nelson. Birch

A small tree resembling the paper birch of the eastern states. Known only from Green Mountain near Boulder.

Betula fontinalis Sarg. Canyon Birch

A handsome tall shrub or small tree with shining leaves. Along watercourses.

Altitude: 5,250 to 10,000 ft. Collections; St. Vrain Creek; Bear Canyon; South Boulder Canyon; Allenspark; Sugarloaf Mountain; foot of Long's Peak; "Eldora to Baltimore" (Rydberg).

Betula glandulosa Michx. Swamp Birch

A shrub about 1 meter high growing in mountain bogs and along streams.

Altitude: 8,500 to 11,000 ft. Collections: Redrock Lake; west of Ward; Goose Lake near Arapahoe Peak; Bald Mountain; "Eldora to Baltimore" (Rydberg).

CORYLACEAE, Hazel-Nut Family

Corylus rostrata Ait. Hazel

A tall shrub growing in clumps.

Altitude: 5,500 to 8,000 ft. Collections: Gregory Canyon; South Boulder Canyon; Sugarloaf Mountain; "lower Boulder Canyon" (Rydberg).

ULMACEAE, Elm Famly

Celtis reticulata Torr. Hackberry

This is *C. occidentalis* of Coulter's *Manual.* An elm-like tree of exposed ridges and foothills. Rather rare in Boulder County.

Altitude: 5,000 to 6,500 ft. Collections: Valmont Butte; Sunshine Canyon; gulch near Boulder Cemetery; "plains and foothills near Boulder" (Rydberg).

CANNABINACEAE, Hemp Family

Humulus lupulus neo-mexicanus Nels. and Ckll. Mountain Hops

Trailing on the ground or over bushes and rocks in shaded situations.

Altitude: 4,900 to 8,000 ft. Collections: Near Boulder; Sugarloaf Mountain.

LORANTHACEAE, Mistletoe Family

Razoumofskya americana (Nutt.) Kuntze. Mistletoe

Parasitic on the lodgepole pine.

Collections: Sugarloaf Mountain; near Rollinsville; near Pine Glade School; "Sunset" (Rydberg).

Razoumofskya cryptopoda (Engelm.) Kuntze. Mistletoe

Parasitic on the rock pine, often causing the formation of so-called "witches' brooms."

Collections: Mt. Alto Park; "Between Sunshine and Ward" (Rydberg).

RANUNCULACEAE, Crowfoot Family

Clematis ligusticifolia Nutt. Virgin's Bower.

Climbing over trees and bushes along streams and in canyons.

Altitude: 4,900 to 7,000 ft. Collections: near Boulder; Sunshine Canyon; St. Vrain Creek below Lyons.

BERBERIDACEAE, Barberry Family

Berberis aquifolium Pursh. Oregon Grape

A low, trailing undershrub with leaves resembling holly. Mostly on south slopes in exposed situations.

Altitude: 5,000 to 9,500 ft. Collections: near Boulder; South Boulder Creek; "near Boulder" (Rydberg).

HYDRANGEACEAE, Hydrangea Family

Edwinia americana (T. and G.) Heller. Wax Flower

A handsome shrub of rather dry and exposed rocky places.

Altitude: 5,500 to 10,000 ft. Collections: Sunset; Head of Gregory Canyon; Boulder Falls; Sugarloaf Mountain; Eldora; foot of Long's Peak; "Eldora to Baltimore" (Rydberg).

GROSSULARIACEAE, Gooseberry Family

Ribes lentum (Jones) Coville and Rose.

Altitude: 8,000 to 11,000 ft. Collection: "Eldora to Baltimore" (Rydberg).

Ribes longiflorum Nutt. Flowering Currant

A shrub with a profusion of yellow flowers in early spring. Along creek flood-plains and canyon mouths.

Altitude: 5,000 to 6,000 ft. Collections: north of Boulder; mouth of Gregory Canyon; "Boulder" (Rydberg).

Ribes parvulum (A. Gray) Rydberg.

A low trailing shrub growing usually in moist places.

Altitude: 8,000 to 11,500 ft. Collections: Redrock Lake, west of Ward; Fourth of July Mine.

Ribes pumilum Nutt. Wild Currant

Among rocks on hillsides.

Altitude: 5,000 to 10,000 ft. Collections: South Boulder Canyon; Sunshine Canyon; Copeland's; "near Boulder" (Rydberg).

Ribes purpusi Koehne. Gooseberry

In somewhat moist situations in gulches and along streams.

Altitude: 6,000 to 10,000 ft. Collections: Boulder County; South Boulder Canyon, altitude 6,800 ft.; "between Sunshine and Ward" (Rydberg).

Ribes vallicola Greene. Gooseberry

Along streams and in gulches.

Altitude: 5,000 to 9,000 ft. Collections: St. Vrain Creek below Lyons; Pine Glade School.

ROSACEAE, Rose Family

Cercocarpus parvifolius Nutt. Mountain Mahogany

On dry hillsides and ridges sometimes forming a rather dense "scrub."

Altitude: 5,000 to 9,000 ft. Collections: near Boulder; South Boulder Canyon; Flagstaff Mountain; "Boulder" (Rydberg).

Dasiphora fruticosa (Linn.) Rydb. SHRUBBY CINQUEFOIL

Handsome flowering shrub in moist meadows and along streams.

Altitude: 8,000 to 10,500 ft. Collections: Allenspark; Mt. Alto Park; Eldora; Redrock Lake, west of Ward.

Holodiscus dumosus (Nutt.) Heller. MEADOWSWEET

A handsome white-flowered shrub resembling some of the cultivated species of *Spiraea*. Rare in Boulder County but well-known farther south.

Altitude: 7,000 to 8,500 ft. Collections: a single specimen collected by J. I. McFarland in 1881 is labeled "Boulder County." Not seen in Boulder County by the writer.

Kunzia tridenta (Pursh) Spreng.

A low, much-branched shrub of rocky hillsides.

Altitude: 6,500 to 8,500 ft. Collections: Head of Gregory Canyon; north of Naderland.

Opulaster glabratus Rydb. NINE BARK

A dwarf shrub on ridges and in gulches.

Altitude: 5,000 to 10,000 ft. Collections: Bluebell Canyon; South Boulder Canyon; Sugarloaf Mountain; "Boulder" (Rydberg).

Opulaster intermedius Rydb. NINE BARK

On moist cliffs and in gulches.

Altitude: 6,000 to 8,600 ft. Collections: Sugarloaf Mountain; Eldora; "lower Boulder Canyon" (Rydberg).

Opulaster monogynus (Torr.) Kuntze. NINE BARK

A medium-sized shrub on moist hillsides and in gulches. This is the best of our native species of *Opulaster* for planting as an ornamental shrub.

Altitude: 6,000 to 9,000 ft. Collections: Bluebell Canyon; Gregory Canyon; North Boulder Canyon; Spencer Mountain at Eldora.

Opulaster ramaleyi A. Nels. NINE BARK

A shrub sometimes two meters high. In canyons and gulches.

Altitude: 5,000 to 9,000 ft. Collections: near Boulder; Boulder Canyon near mouth; Gregory Canyon; Boulder Canyon near mouth of Fourmile; Boulder Falls; Magnolia; Eldora.

Rosa aciculata Ckll. WILD ROSE

Altitude: 6,000 to 9,000 ft. Collection: "mountains between Sunshine and Ward." (Rydberg).

Rosa engelmanni S. Wats. WILD ROSE

Altitude: probably from 6,000 to 10,000 ft. Collections; Eldora; foot of Long's Peak; Boulder Canyon, 7,340 ft.

Rosa fendleri Crepin. WILD ROSE

Altitude: 5,000 to 9,000 ft. Collections: Marshall; above Magnolia; "Boulder; between Sunset and Ward" (Rydberg).

Rosa nutkana Presl. WILD ROSE

This and the next following species are among the showiest of our roses.

Altitude: 5,000 to 9,000 ft. Collections: Marshall; Bluebell Canyon; head of Gregory Canyon; Pine Glade School.

Rosa pratincola Greene. WILD ROSE

Altitude: 4,900 to 7,000 ft. Collections: near Boulder; South Boulder Canyon; mouth of Gregory Canyon.

Rosa sayi Schwein. WILD ROSE

Altitude: 5,000 to 10,000 ft. Collections: South Boulder Canyon, 6,800 ft.; Copeland's; "Eldora to Baltimore" (Rydberg).

Rosa woodsii Lindl. WILD ROSE

Altitude: 6,000 to 9,000 ft. Collections: Sugarloaf Mountain; Bluebird Mine; Spencer Mountain at Eldora.

Rubus deliciosus James. THIMBLE BERRY

A shrub, with large handsome, white flowers on hillsides and in gulches. Very common. Sometimes planted for ornament.

Altitude: 5,000 to 10,000 ft. Collections: Valmont Butte; South Boulder Canyon; Sugarloaf Mountain; "gulch south of Boulder" (Rydberg).

Rubus parviflorus Nutt. FLOWERING RASPBERRY

A trailing shrub in moist situations among rocks or in shade of trees and bushes.

Altitude: 7,000 to 9,000 ft. Collection: Magnolia.

Rubus strigosus Michx. RED RASPBERRY

This is our common prickly raspberry on mountain roads and hillsides.

Altitude: 6,000 to 10,000 ft. Bear Canyon; South Boulder Canyon; Bluebird Mine; near Ward.

POMACEAE, APPLE FAMILY

Amelanchier alnifolia Nutt. JUNE BERRY

Altitude: 5,000 to 9,000 ft. Collections: Sunshine Canyon; Eldora.

Amelanchier elliptica A. Nels. JUNE BERRY

On hillsides and slopes.

Altitude: 6,000 to 8,500 ft. Collections: Sugarloaf Mountain.

Amelanchier oreophila A. Nels. JUNE BERRY

Altitude: probably 5,000 to 8,000 ft. Collection: near Boulder.

Crataegus erythropoda[1] Ashe. THORN APPLE

A shrub or small tree with thin, shining leaves, deeply cut and with sharp teeth. Found in open canyons and draws; associated with other species of *Crataegus* to form dense thickets.

Altitude: 5,500 to 6,500 ft. Collections: mouth of Gregory Canyon; "Boulder" (Rydberg).

[1] In the genus *Crataegus* I have used the names suggested by Professor T. D. A. Cockerell in his article in this number of the *Studies*. Thus I have written *C. erythropoda* Ashe, in place of *C. cerronis* A. Nels. and *C. coloradensis* A. Nels. in place of *C. occidentalis* Britt., as used by Rydberg in his *Flora of Colorado*. (See Professor Cockerell's article in these *Studies*, Vol. V, p. 41.)

Crataegus colorado Ashe. THORN APPLE

A shrub or small tree with thick, rough leaves; forming thickets in open gulches of mesas and lower foothills.

Altitude: 5,500 to 6,500 ft. Collections: near Boulder; Gregory Canyon.

Crataegus coloradensis A. Nelson.[1] THORN APPLE

Similar in appearance to *Crataegus colorado* and occurring in the same situations.

Altitude: 5,500 to 6,500 ft. Collections: Bluebell Canyon; near Boulder; "lower Boulder Canyon" (Rydberg).

Sorbus scopulina Greene. MOUNTAIN ASH

Distribution in Boulder County is not known to the writer. A single specimen collected by Mr. W. W. Robbins near Tolland came from near the line between Boulder and Gilpin counties.

DRUPACEAE, PLUM FAMILY

Prunus americana Marsh. WILD PLUM

Scattered along streams at canyon mouths.

Altitude 5,000 to 8,000 ft. Collections: Bluebell Canyon; Sunshine Canyon; Flagstaff Mountain; "Boulder" (Rydberg).

Prunus besseyi Bailey. SAND CHERRY

On rock ridges and slopes. Apparently rare in the county.

Altitude: about 5,000 ft. A specimen was photographed, but not collected, at White Rocks.

Prunus melanocarpa (A. Nels.) Rydb. CHOKE CHERRY

A shrub usually growing in clumps. Common in slightly moist places in foothill region.

Altitude: 5,000 to 9,000 ft. Collections: Valmont Butte; near Boulder; South Boulder Canyon; Bluebell Canyon; lower Gregory Canyon; north of Boulder; head of Gregory Canyon; Sugarloaf Mountain; near Long's Peak.

Prunus pennsylvanica Linn. f. WILD CHERRY

Moist hillsides and open woods, not common.

Altitude: 6,000 to 9,000 ft. Collections: Eldora; "Eldora to Baltimore" (Rydberg).

PAPILIONACEAE, PULSE FAMILY

Amorpha angustifolia (Pursh) Boynton

Altitude: 4,900 to 5,500 ft. Collection: near Boulder.

SPONDIACEAE, SUMAC FAMILY

Rhus glabra Linn. SUMAC

A medium-sized shrub generally growing in masses on mesa tops, canyon sides, and slopes. The leaves turn a handsome red in the autumn.

Altitude: 5,500 to 7,500 ft. Collections: Bear Canyon; near Magnolia; "lower Boulder Canyon" (Rydberg).

Rhus rydbergii Small. POISON IVY

A shrub or trailing vine common on moist hillsides and in gulches. Attaining greatest size at canyon mouths. Easily recognized by the three-parted dark green leaves which

[1] This is probably the *Crataegus occidentalis* of Rydberg's *Flora of Colorado.*

become a handsome orange-red in autumn. The greenish-white clusters of berries remain during the winter.

Altitude: 4,900 to 7,500 ft. Collections: Valmont Butte; Gregory Canyon; "foothills near Boulder" (Rydberg).

Rhus trilobata Nutt. SKUNK BUSH

A low shrub of dry hillsides and rocky places; very common. The leaves become orange-red and copper-colored in autumn.

Altitude 5,000 to 7,500 ft. Collections: Valmont Butte; hillside, Bluebell Canyon; South Boulder Canyon; "Boulder" (Rydberg).

ACERACEAE, MAPLE FAMILY

Acer glabrum Torr. MOUNTAIN MAPLE

A small tree or shrub along streams and gulches to the foot of the range. It would be valuable for ornamental purposes.

Altitude: 4,900 to 9,000 ft. Collections: Bluebell Canyon; Sunshine Canyon; Sugarloaf Mountain; Eldora.

Acer negundo Linn. BOX ELDER

A tree of lower foothills and plains regions along streams and on moist hillsides.

Altitude: 4,900 to 6,500 ft. Collections: east of University campus; near Boulder; St. Vrain Creek below Lyons.

Acer texanum Pax. BOX ELDER

This species is very similar to the preceding and probably has the same distribution. Collections: Bear Canyon; Bluebell Canyon; "foothills near Boulder" (Rydberg).

FRANGULACEAE, BUCKTHORN FAMILY

Ceanothus fendleri Gray. NEW JERSEY TEA

A low, thorny shrub of dry hillsides; very common.

Altitude: 5,500 to 9,500 ft. Collections: near Boulder; South Boulder Canyon; head of Gregory Canyon; hill north of Nederland; "Boulder; between Sunhsine and Ward" (Rydberg).

Ceanothus pubescens (T. and G.) Rydb. NEW JERSEY TEA

A small shrub on mesas and foothills.

Collections: Bluebell Canyon; Eldora; "Boulder" (Rydberg).

Ceanothus subsericeus Rydb. NEW JERSEY TEA.

A low shrub on plains and lower foothills.

Altitude: 5,000 to 6,500 ft. Collections: plains north of Marshall; Boulder Canyon near mouth of Fourmile.

Ceanothus velutinus Dougl. NEW JERSEY TEA

Shrub with handsome dark green leaves growing in clumps; slightly moist soil of hillsides and gulches.

Altitude: 6,000 to 9,000 ft. Collections: Bear Canyon; Eldora; near foot of Long's Peak; "between Sunshine and Ward" (Rydberg).

VITACEAE, GRAPE FAMILY

Parthenocissus vitacea Hitchc. VIRGINIA CREEPER

Climbing in trees and over rocks in river-bottom forests and at canyon mouths.

Altitude: 4,900 to 6,000 ft. Collections: near Boulder; Gregory Canyon; St. Vrain Creek below Lyons; "near Boulder" (Rydberg).

Vitis vulpina Linn. WILD GRAPE

Altitude: 4,900 to 7,000 ft. Collections: Sunshine Canyon; mouth of Gregory Canyon; St. Vrain Creek below Lyons; mouth of Boulder Canyon; "Boulder" (Rydberg).

ELAEAGNACEAE, OLEASTER FAMILY

Lepargyraea canadensis (Linn.) Greene. BUFFALO BERRY

A low shrub with leaves dark green above and silvery below. In woods and somewhat shaded places.

Altitude: 6,500 to 10,000 ft. Collections: near Magnolia; head of Gregory Canyon; Sugarloaf Mountain; Eldora; Spencer Mountain at Eldora; "Eldora to Baltimore" (Rydberg).

ARALIACEAE, ARALIA FAMILY

Aralia nudicaulis Linn. WILD SARSAPARILLA

Although this is hardly a woody plant it is included here because sometimes mistaken for poison ivy. Gulches and under deciduous trees and shrubs.

Altitude: 5,000 to 8,000 ft. Collections: South Boulder Canyon; "Boulder" (Rydberg).

CORNACEAE, DOGWOOD FAMILY

Cornus stolonifera Michx. DOGWOOD

A shrub with red twigs and ovate leaves, the latter with distinct venation. Streambanks and gulches.

Altitude: 5,000 to 9,000 ft. Collections: Gregory Canyon; South Boulder Canyon; near Boulder Falls; Sugarloaf Mountain.

ERICACEAE, HEATH FAMILY

Arctostaphylos uva-ursi (Linn.) Spreng. KINNIKINIK, BEARBERRY

A prostrate, thick-leaved, evergreen plant of hillsides and mesas. Very common.

Altitude: 5,500 to 10,500 ft. Collections: South Boulder Canyon; Sugarloaf Mountain; Pine Glade School; Eldora; Copeland's.

Gaultheria humifusa (Graham) Rydb. CREEPING WINTERGREEN

Altitude: 10,000 to 11,000 ft. Reported by Mr. D. M. Andrews from Fourth of July Mine.

Kalmia microphylla (Hook.) Heller. DWARF LAUREL

A low, delicate woody plant with handsome pink flowers. It occurs in swampy places at the foot of the main range.

Altitude: 10,000 to 11,000 ft. Collections: Camp Albion; foot of Arapahoe Peak; Fourth of July Mine; "Caribou" (Rydberg).

VACCINIACEAE, HUCKLEBERRY FAMILY

Vaccinium caespitosum Michx. DWARF BILBERRY

A stiff, much-branched shrub with small leaves and small, blue, edible berries. In coniferous forests and on open hillsides.

Altitude: 8,000 to 11,000 ft. Collection: "Eldora to Baltimore" (Rydberg).

Vaccinium erythrococcum Rydb. Red Bilberry

A low shrub with very small leaves and bright red berries. Hills and forest openings.

Altitude: 8,500 to 11,000 ft. Collection: Boulder County.

Vaccinium oreophyllum Rydb. Blueberry, Huckleberry

Low shrub with angled branches and leaves about 1.5 cm. long; berry purplish-black. Very common in coniferous forests at about 10,000 ft.

Altitude: 8,000 to 11,500 ft. Collections: Bald Mountain near Ward; Redrock Lake above Ward; Fourth of July Mine; foot of Long's Peak.

APOCYNACEAE, Dogbane Family

Apocynum ambigens Greene. Dogbane

This and the other species are perhaps technically herbs but are included here because of their general appearance.

Altitude: 6,000 to 8,000 ft. Collections: Bear Canyon; head of Gregory Canyon; "Boulder" (Rydberg).

Apocynum androsemaefolium Linn. Dogbane

A low, branching shrubby plant with an abundance of pink flowers in midsummer. Hillsides and forests.

Altitude: 6,500 to 9,000 ft. Collections: South Boulder Canyon; north of Nederland; Boulder County.

Apocynum cannabinum Linn. Indian Hemp

In river-bottom forests of the plains and lower foothills.

Altitude: 4,900 to 6,500 ft. Collections: along the railroad track near Boulder station; Bluebell Canyon; "Boulder" (Rydberg).

Apocynum hypericifolium Ait. Dogbane

Altitude: 5,000 to 6,000 ft. Collections: valley east of Boulder; "Boulder" (Rydberg).

Apocynum lividum Greene. Dogbane

Altitude: 6,000 to 9,000 ft. Collection: Eldora.

Apocynum scopulorum Greene

Altitude: 6,000 to 9,000 ft. Collection: Sugarloaf.

CAPRIFOLIACEAE, Honeysuckle Family

Linnaea americana Forbes. Twin-Flower

Low, trailing, evergreen plant with delicate pink flowers in two's on long peduncles. Coniferous forests and north slopes.

Altitude: 7,500 to 12,000 ft. Collections: Magnolia; Eldora; Spencer Mountain at Eldora; Foot of Arapahoe Peak; hill south of Ward; "South Boulder Peak" (Rydberg).

Distegia involucrata (Richardson) Ckll. Fly Honeysuckle

A tall shrub in cold soil along stream-banks with deciduous trees. Common between 8,000 and 9,000 ft.

Altitude: 6,500 to 10,000 ft. Collections: South Boulder Canyon; Allenspark; Eldora; Spencer Mountain at Eldora; Redrock Lake west of Ward; near Ward; "between Sunshine and Ward" (Rydberg).

Sambucus melanocarpa A. Gray. BLACK-BERRIED ELDER

A medium-sized shrub with large, compound-pinnate leaves; on slopes and among rocks.

Altitude: 8,000 to 9,500 ft. Collections: Sugarloaf Mountain; North Boulder Creek.

Sambucus microbotrys Rydb. RED-BERRIED ELDER

In somewhat moist soil among willows and aspens.

Altitude: 7,500 to 12,000 ft. Collections: Spencer Mountain at Eldora; Silver Lake; foot of Long's Peak; Redrock Lake, west of Ward; "between Sunshine and Ward" (Rydberg).

Symphoricarpos occidentalis Hook. SNOWBERRY, INDIAN CURRANT

A stout shrub with thick leaves and numerous small flowers in axillary clusters; these followed by small globular white berries. Along roadsides and edges of fields in slightly moist places.

Altitude: 4,900 to 8,000 ft. Collections: near Boulder; South Boulder Creek; Mouth of Gregory Canyon; Boulder County; "Boulder; between Sunshine and Ward" (Rydberg).

Symphoricarpos oreophilus A. Gray. INDIAN CURRANT

Altitude: 7,500 to 10,000 ft. "Eldora to Baltimore" (Rydberg).

Symphoricarpos vaccinoides Rydb. INDIAN CURRANT

A low shrub with small leaves, having somewhat the appearance of a huckleberry bush. Steep slopes and rocky places.

Altitude: 7,000 to 10,000 ft. Collections: Sugarloaf; foot of Long's Peak.

Viburnum lentago Linn. SWEET VIBURNUM

A small tree or shrub with ovate leaves, serrate margined; flowers in many-rayed cymes; the black stone-fruits are sweet and edible.

Distribution probably rare and local, perhaps introduced. Collections: Bluebell Canyon; "gulch south of Boulder" (Rydberg).

Viburnum pauciflorum Pylaie. HIGH-BUSH CRANBERRY

This is a straggling shrub with three-lobed ovate leaves and cymes of small flowers. The red stone-fruits have an acid flavor with a fancied resemblance to that of cranberry.

Altitude: about 8,000 ft. Collection: Sugarloaf Mountain.

CARDUACEAE, THISTLE FAMILY

Chrysothamnus graveolens (Nutt.) Greene. RABBIT BUSH

A spreading shrub with long filiform leaves. In the spring of the year these plants look like straggling bushy pines.

Altitude: probably from 4,900 to 8,000 ft. Collections: "Boulder" (Rydberg). Seen by the writer on the end of a mesa south of the Chautauqua grounds near Boulder.

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THE HABITATION TAX[1]

By John Burton Phillips

Additional sources of public income are essential to modern efficient government. This is due to the great demand for increased revenue, and the need of a substitute for the general tax on personal property. The growth of urban population has made necessary additional taxes. A city government is more costly than governments of purely rural communities with their freedom from sewer, water, lighting, and police expenses. The increase of taxation that has to be borne by the city dwellers falls primarily on property within the corporate limits. In theory, all taxation in modern cities is levied on the real and personal property therein, but in reality, the tax is very largely contributed by the realty. It is well known that personal property everywhere does not contribute its share of taxation. Hence, in the selection of new sources of taxation, efforts should be made to relieve real estate as much as possible from the undue proportion of taxation which it now bears by securing from the owners of personalty the proportion of tax which they ought in equity to pay. The complications in the present method of assessing personal property render evasion easy and justice impossible. The new methods should conform as nearly as possible to the established principles of taxation. The more important of these principles are the following:

1. A tax should be levied according to the ability of the taxpayers to contribute. This principle is so obvious that it needs no discussion. The other theories of taxation, such as benefit and sacrifice, seem to have been largely abandoned, and ability accepted as the fundamental principle.

2. Again, a tax should be certain both as to its amount and payment. The amount to be paid should be definitely known both to the taxpayer and to everyone else in the same community.

[1] Paper read at the National Conference on State and Local Taxation, Columbus, Ohio, November 12–15, 1907.

3. A tax should be so contrived that its assessment and collection may be made with a minimum of expense. Its levy should be simple, requiring no detailed inquisition into the affairs of the taxpayer, as this will tend to deprive it of public support by affording apparent justification for its resistance.

These are the principal canons of taxation laid down by Adam Smith and if carefully followed undoubtedly furnish the basis of an ideal revenue system.

As a substitute for the tax on personal property the tax on rentals, or "habitation tax" as it has been called, has been recommended as conforming in large measure to the above principles. This is a tax levied upon the occupiers of residences according to the rental value of the places they occupy. In order to attain substantial justice, the rentals of property below a certain amount are exempt from the tax. This exemption is felt to be necessary because the smaller properties are now bearing far more than their proportion of taxation, and again, a certain amount must be expended for subsistence before any considerable degree of tax-paying ability emerges. In the more recent proposals of this tax it applies only to the rentals of buildings occupied as dwellings. Business properties are exempt. It is felt that such buildings are effectively reached by other kinds of taxes.

This tax is not proposed as a sufficient source of revenue. From a financial point of view it is defective in elasticity, as are all taxes levied at a flat rate upon property which does not vary greatly from year to year. It is therefore necessary to provide in some of the other taxes for the variations to be introduced as the fiscal needs change. This should not be omitted, as an inelastic system of taxation by bringing in a surplus of revenue in prosperous years may lead to extravagant undertakings and unwarranted expenditures on the part of the legislators, and it is wise to shield them from the temptations of an overflowing treasury.

The habitation tax is brought forward as a supplemental tax to serve as a part of a general system. It is offered as a substitute for the tax on personalty and it is believed to contain features that will make it adaptable to modern conditions and various localities with a minimum of friction.

Theoretically, the income tax is regarded as approaching most nearly to the principle of ability, and for a number of years this tax has been expected to furnish the means of escape from the inequalities in the taxation of general property. Increasing study of the abuses inherent in the practical operation of the income tax in those countries where it has become a settled part of the fiscal system has weakened the faith in the efficiency of this tax to reach considerable classes of personal property. When the income tax is applied on the principle of stoppage at source—taking the tax out of the dividends before they are paid to the stockholder—it has proven successful. Its greatest defect is in the fact that it must rely upon the declaration of the taxpayer as to the amount of his income derived from investments in notes, mortgages, bonds, and other securities to which the principle of stoppage at source cannot be applied. In the ascertainment of this part of the income, the tax has become subject to abuse. In so far as the income tax is successful, much the same result is now obtained in some of the American states by the use of corporation taxes. Thus, while the practical results of the income tax are secured in the taxation of corporate property, the tax on rentals has been proposed in the endeavor to reach that species of property not effectively reached either by taxes on income or corporations.

The expenditure for house rent is generally some indication of the occupant's income. It is true it is not an absolute measure of income, but in a general way, differences in rent tend to approximate diffrences in tax-paying ability. Normal persons are fond of material comforts and luxuries, and an increase in income generally expresses itself at once in larger and more elaborate homes. It is also claimed that the habitation tax reaches funded income and taxes it at a higher rate than income from services, such as the income of lawyers and physicians.[1] In all schemes of income taxation an effort is made to make this discrimination so as to avoid the hardship in taxing income derived from service at the same rate as income derived from government bonds or other permanent investments. The tax on rentals, it is said, reaches income from investments and taxes it at a higher rate than income from service because, in so far as the residence is the index of income, it is

[1] LEROY-BEAULIEU, *Traité de la science des finances*, Part I, Book II, chap. vii.

likely to vary with the amount of wealth, and in consequence, those persons having an income from investments in government bonds and other securities, and with a reasonable assurance of its permanence, will have more elaborate habitations than those obliged to secure an income from their personal services, for the latter will of necessity feel themselves obliged to save a part of their earnings. Hence, they will not be able to spend so much on a habitation. Thus, it seems, the tax on rentals taxes the income derived from invested funds at a higher rate than that derived from service and so conforms to the ideal scheme of an income tax.

In the French cities where the tax on rentals is in operation, a progressive scale has been adopted. The houses are classified according to their rental value. As a rule those with a rental below 500 francs are exempt. The rates on the other classes vary from year to year according to the fiscal needs of the community.[1]

In defense of this progression it is said that the lower in the social scale you go the higher is the proportion house rent bears to the total expense or income. The poor spend a much larger proportion than the rich for the rent of their homes. It has been claimed that a progressive rate of taxation on rentals would counterbalance the decreasing proportion rent bears to the total expense. While there is truth in this, it should be remembered that expenditure is only an approximate measure of a man's income or ability to pay taxes. In a country like the United States where the democratic ideal is strongly emphasized, the amount of rent paid is a more uncertain index of income than in countries where social classes are more sharply defined. This is especially true of the middle and lower middle classes. However, this objection to the progressive feature becomes less serious if the rental exempted from taxation is reasonably large.

[1] In the year 1890 the following rates prevailed:

Rentals to	599	francs	. . . . .	6½ per cent.
" "	699	"	. . . . .	7½ per cent.
" "	799	"	. . . . .	8½ per cent.
" "	899	"	. . . . .	9½ per cent.
" "	999	"	. . . . .	10½ per cent.
"	above 1,000	"	. . . . .	11.74 per cent.

—Léon Say, *Dictionnaire des finances*, Vol. II, p. 854 (given in Seligman, *Progressive Taxation*, p. 56).

The two principal criticisms of the habitation tax are the following: first, it would not reach the rich bachelor who as a rule does not maintain an expensive residence; second, it would tend to put an additional burden on persons with large families.

It is true this tax would not reach rich bachelors in the same degree as persons of family. A bachelor may be a boarder in the family of a much poorer individual whose rent is large enough to render him liable to the habitation tax. Probably the best method of meeting cases of this kind is to rely upon the inheritance tax. On the assumption that those not reached by the habitation tax are enabled to accumulate more wealth, the death duty will make up for the loss by the tax on rentals. As to the second objection, a scale might be adopted by which the size of the family would be taken into consideration and the rate of taxation adjusted in such a manner as to give the heads of the larger families the benefit, and place an additional burden upon those smaller households desiring to maintain expensive establishments. It would not be difficult to lower the rate of taxation somewhat in cases in which the family exceeds a certain number, or to exempt such families altogether. In Tasmania a reduction is made for each child. In this way the most serious objection to the habitation tax might be removed.

One of the latest proposals of this tax is that in the minority report of the New York Special Tax Commission of 1906. This recommends that the personal property tax be abolished and the tax on rentals substituted. It proposes to levy the tax at a graduated rate. The sum to be deducted from the total rent before the tax was to be imposed varies according to the size of the cities: In cities of the first class (250,000 inhabitants or more), $600; in cities of the second class (50,000 to 250,000 inhabitants), $400; in cities of the third class (under 50,000 inhabitants) and in incorporated villages, $200; in towns and unincorporated villages $100.[1] This variation in the amount of exemption is an attempt on the part of the committee to adjust the tax in some degree to the differences in rents which exist in the different cities of the state. Rents are higher in New York City and Buffalo than in the other cities and smaller towns.

[1] Report of New York Special Tax Commission, 1906, p. 172.

The rates of taxation recommended by the New York commission are interesting as showing the graduation. They are as follows:[1]

Rental	Rate of Taxation
$2,000 or less	3 per cent.
$2,000 to $5,000	5 per cent. on excess above $2,000
$5,000 to $10,000	10 per cent. on excess above $5,000
$10,000 to $20,000	15 per cent. on excess above $10,000
$20,000 and over	20 per cent. on excess above $20,000

A habitation is defined as a building or part of a building used as a place of abode by one or more persons forming a single household and such other buildings in connection therewith as are used for the purpose of residence, but not such buildings or parts of buildings used for business purposes. Different parts of buildings, rooms or suites of rooms in hotels serving as places of abode for guests or lodgers having no households, are considered as habitations for the purpose of taxation. "Occupant" is defined as a person who as head of a household occupies a place of abode within the meaning of this article for a period of three months of the preceding year, either for himself or for his family or dependents or boarders or lodgers. The liability to the tax after a three months' occupation is designed to reach that considerable class of persons which possesses residences in the summer and winter resorts of the country.

The New York commissioners in recommending the tax on rentals did not urge its adoption as a law applying to the entire state, regardless of the desires of the local units. The bill which they propose provides that the board of supervisors of any county or the common council of any city may exempt from taxation the personal property within the limits of such county or city and substitute the tax on habitations. This is the local-option feature and is considered wise, as it is possible that many of the local units in which wealth is more evenly distributed would prefer to continue the assessment of personal property by the general property tax. The general property tax on personalty is not the failure in the rural districts that it has become elsewhere.

The local-option feature of the proposed law is especially wise in the present state of public opinion. It is most unlikely that any legislative body will soon adopt what seems so radical a form of taxation if it is to apply at once to the entire state. If, however, the bill has the local-

[1] Report of New York Special Tax Commission, 1906, p. 172.

option feature and will not go into operation anywhere until it has been adopted by the local legislative body, it is quite possible that the state legislature might much more easily be induced to consider it. This was the manner in which the tax was introduced in Montreal. The charter made the tax permissive, and the council decided to adopt it.[1] Altogether, the proposed habitation tax as recommended by the minority of the New York commission represents perhaps the most scientific development of the idea of this kind of taxation. The commissioners deserve great credit for the skill with which they have worked out and presented their plan.

One of the great advantages of this kind of taxation is the large increase in revenue that could easily be made to follow its adoption. The anticipated increase in revenue is set forth by a table in the report of the minority of the New York Special Tax Commission of 1906. This table is made up of actual figures taken from the assessors' rolls and shows the increase in revenue that might be secured. In the table the rental is estimated at 8 per cent. of the assessed value of the premises.[2]

Nominal Designation	Personal Assessment	Value of Residence (Land and Building)	Present Tax on Personalty	Tax under New Law
A	$300,000	$1,600,000	$4,436	$22,792
B	150,000	2,745,000	2,218	40,112
C	100,000	1,200,000	1,478	17,392
D	50,000	765,000	739	10,442
E	50,000	490,000	739	6,032
F	100,000	590,000	1,478	7,532
G	1,000,000	3,000,000	14,780	46,192

From this table it is clear that these wealthy taxpayers would pay by this tax from three to twenty times the amount they are now paying in personal taxes. The wealthy resident whose intangible personal property now so largely escapes taxation would be reached and the exemption of the lower rentals from the tax would relieve the tenement-house population and also the large class of persons whose rents are so considerable a part of their expenses of living. At the same time the revenue derived would greatly exceed that which is now yielded by the tax on personalty.

[1] "Charter of the City of Montreal (1899)," Article 363.—*Quebec, 62 Victoria*, chap. 58.

[2] *Report of New York Special Tax Commission*, 1906, pp. 53 54.

Another advantage of the habitation tax as a tax on income not reached by the corporation taxes is that it will fall on those most able to bear it who now in great measure evade the general tax on personal property. It has been shown that the tax upon the rental value of property cannot be shifted, but falls upon the occupier alone, save under exceptional conditions.[1] Thus this tax on rentals would reach the class desired to be reached and would have to be borne by them alone, namely, the class occupying the more expensive kinds of dwellings. As the tax falls upon the person paying the rent, it cannot be said to be an additional burden placed upon real estate. In those cases in which the owner is also the occupier the tax may be regarded as a tax on the funded income of those not reached by other taxes. The general effect would then be to lessen the tax burden now levied on real estate.

One of the greatest problems of modern finance is to lighten the burden of local real-estate taxation. Owing to the evasions of the personalty owners and their escape from the assessor, the tax needed for local purposes, and in most states, state revenues as well, has to be levied very largely on the owners of real estate. The increased demand for urban residential property enables these owners to shift a large amount of the tax to the tenants and, hence, the high rents. In so far as the habitation tax as recommended by the minority of the New York commission might be made to produce a considerable revenue for local purposes, it is inevitable that the tax on real property would be lessened and in consequence rents would fall. The social and industrial advantages of a change of this kind would be very great, since rent is so important a factor in increasing the congestion of population.

The habitation tax conforms in a high degree to the principle of certainty that has already been laid down. If a person does not change his residence and if the rate of tax on rentals is not changed from year to year, each taxpayer in the community knows what his tax will be and also what the amount is that each of his neighbors will have to pay, as the rent of buildings is usually fairly well known.

At the present time much of the lack of interest in the problems of taxation and the consequent slowness of reform in this kind of legislation

[1] SELIGMAN, *On the Shifting and Incidence of Taxation*, p. 127.

are due to the utter ignorance of the citizens of the local units as to the amount of tax which their neighbors pay. Save in the rural districts, few taxpayers know what the assessment is of the property adjoining their own, and they are much less likely to know the amount of personalty assessed to the citizens of their community. Publication of the assessors' rolls in the newspapers would certainly quicken interest in questions of taxation, whatever might be the other results.[1]

There are two reasons why the habitation tax would not cause much friction in its operation. One is the ease with which it might be assessed and the accompanying impossibility of deception, and the other is the absence of anything in the nature of an inquisition into the affairs of the taxpayers. These are advantages of no slight importance.

In placing a tax on rentals it is only necessary to know the amount of the rental, and this is more or less common knowledge in the entire neighborhood. If it is not, it is very easy to ascertain. The modifications of the tax that have been suggested, as in the case of the change of the rate for bachelors and for families with numerous children, are also changes that are dependent upon certain well-known or at least easily discovered facts. Hence in the assessment of this tax there would be scant opportunity for deception or collusion, and no one could find fault with the amount levied upon his neighbor.

One of the very great advantages of this tax is that it does away with the necessity of inquiring into the affairs of the taxpayers and securing affidavits from them. In America one of the government acts most resisted is the investigation of a person's private affairs. The absence of social classes and the teachings of more than a hundred years of democracy have developed a strong desire in our citizens to keep to themselves their own financial standing. Therefore, when the assessor demands from the taxpayer an inventory of his wealth, he is frequently met with a refusal or is given a statement far from the truth. The feeling that each person has the right to resist inquisition even on the part of the government is one of the chief reasons for the partial failure of the income tax in the older countries of the world and for its much more complete

[1] Publication of the assessors' rolls is now required by law in Nevada, Rhode Island, and those parts of Illinois where the country system prevails. It is done locally to some extent in Deleware and New Hampshire.

failure in the United States. This is meant to apply to the part of the income that is determined by the statements made by the taxpayer in his declaration. The tax on rentals is therefore in harmony with the feeling of resentment against any inquisition into one's financial ability and would accordingly eliminate much of the friction now characteristic of the fiscal system.

It has been assumed that as a general principle taxes on consumption are bad and this is perhaps true enough to make it a rule that such taxes should not be levied oftener than necessary. Other sources of revenue should be found whenever possible. However, consumption when thought of in this connection is assumed to mean consumption necessary to guarantee the welfare of the community. This was the kind of consumption in vogue when the earlier works on taxation were written and when therefore the principle above mentioned gained general acceptance. With the great increase of wealth in the past half-century, however, and the keener competition among social classes, it seems that consumption has become a thing which it is not safe to use in judging the necessities of the people. It does not indicate expenditure for social welfare but tends rather in many instances to show a desire to consume conspicuously and wastefully. Large classes in the community maintain great establishments not for the sake of necessity but primarily for the sake of the social standing the maintenance of these households gives them. The sense of fitness conforms in considerable degree to the principle of conspicuous waste. In so far as this is true, the criticism of the habitation tax as a tax on consumption loses much of its force.

It is, perhaps, going too far to accept Wagner's theory that taxation is a certain socio-political instrument to be used for the conscious improvement of society.[1] Yet it would seem that if the government is justified in levying some regulative taxes, such as those on certain vices, for the sake of control and repression, it is not doing violence to the imagination to think that wasteful consumption for the sake of display might possibly be considered as somewhat akin and properly subject to taxation. The tax on expensive habitations might have certain sociological results. In so far as its imposition would tend to

[1] WAGNER, *Finanzwissenschaft*, Vol. I, § 27.

check wasteful display in the maintenance of great establishments, it would tend to eliminate a conspicuous form of invidious comparison which at the present time is one of the chief factors determining men to erect immense habitations. A beautiful and expensive residence is a standing witness of the owner's ability to pay, and it at the same time clearly proclaims him in a different class from most of those who view it.

Again, in so far as the habitation tax would tend to reduce the number of magnificent residences, it would have the effect of decreasing the value of real estate and in this event a social gain would accrue to the modern city. The huge private parks surrounding so many of the fine residences in our cities might tend slightly to diminish in size and in this way more of the working-class might have homes in other places than the congested sections where they now reside.

If then the tax on habitations can be so arranged that it will not interfere with the amount of money that must be spent in order to secure for the people their actual welfare, but will only bear on that part of the expenditure which is unnecessary to the well-being of the community, the objections to it as a tax on consumption will in some degree be removed. If the exempted minimum rental is properly adjusted, there can be no serious complaint that such a tax will fall unjustly as a consumption tax upon those least able to bear it.

HISTORY OF THE HABITATION TAX

The tax on the rental values of property is not new. It had its beginning in the action of the Constituent Assembly of France in the year 1791. This assembly erected upon the ruins of the French monarchy sought to construct a new fiscal system that would eliminate the obnoxious features that had been so characteristic of the monarchy preceding. Of these one of the worst was the inquisition into the affairs of the citizens. In seeking, therefore, for new objects of taxation, and also such as would require no inquisition, the members of the assembly resorted to the tax on rentals. Since that time this tax has prevailed in France, though its strict theory is not carried out in all departments. In a number the tax is assessed upon the ability of the citizen to con-

tribute, and this ability is determined by the amount of his rent and also certain other evidences of financial standing.

In 1887 an attempt was made to modify the tax on rentals by increasing the progressive feature so as to enlarge the contribution in proportion to the amount of the rental; but although brought forward as a government measure, the bill was defeated. The scheme was ingeniously worked out by Dr. Koenig, and although failing to become a law served to attract the attention of students to the possibilities of this tax.[1]

The tax on rentals has been in force for a number of years in some of the German cities, among them Berlin, Frankfort, Dresden, and Strassburg. The proportion of the total revenue furnished by the tax is shown by the following table.[2]

Cities	Percentage of All Taxes
Berlin	37.24
Frankfort	19.52
Dresden	22.15
Strassburg	2.81

The habitation tax has existed in Montreal for a number of years but not in the form of a tax on the rentals of residences. It is a business tax, and applies only to the rentals of buildings used for business purposes. The tax is levied at a flat rate of $7\frac{1}{2}$ per cent. on the rentals of all business property which exceed $30 a year. There is no personalty or income tax in Montreal, the entire revenue of the city being raised by the tax on real property and on business rentals with the exception of a few special taxes on banks, insurance companies and financial institutions, and the licenses of horses, dogs, peddlers, woodyards, etc. In 1906 the proportion of the total revenue contributed by the business tax on rentals was $390,548—approximately 9 per cent.[3] The officials look upon the tax with favor.

The tax on rentals has been in force in Tasmania for some time. There it is not assessed directly on the rental but on a sum called the taxable amount, and this sum is determined by multiplying the annual

[1] Dr. Gustave Koenig, *Un nouvel impôt sur la revenu:* Mémoire qui a inspiré le projet du gouvernement relatif à la reforme de la contribution personelle mobilière. Paris, Guillaumin, 1887; quoted by Seligman, *Essays in Taxation*, pp. 371, 372.

[2] Seligman, *op. cit.*, p. 336.

[3] *Report of the Auditor of Montreal*, 1906, pp. 112, 113.

value by various numbers ranging from two and one-half to ten. The size of the rental determines the number to be used in the multiplication. There are three methods of computing the taxable amount according as the property is used for the following purposes: First, residential, or partly residential and partly professional; second, partly residential and partly business; third, lodging.

The taxable amount is highest for the first class, those who occupy buildings as residences wholly or partly as residences and partly for professional purposes; it is lowest for the second class, those who live in the same building where their business is carried on.

To get the taxable amount for persons in the first class, rentals under £30 are multiplied by five. As the rental increases larger multipliers are used. Rentals of £1,000 and over are multiplied by ten. Similar methods are employed to ascertain the taxable amount in the other two classes, only smaller multipliers are used. The taxable amount thus obtained represents a certain graduation. The tax is then levied at a progressive rate on the taxable amount. The following schedule gives an idea of the progression:[1]

When the Taxable Amount Is under £60	The Tax is 2*s.* 6*d.*
£60 and under £100	1*d.* in the pound
£100 and under £115	2*d.* in the pound
£115 and under £150	3*d.* in the pound
£150 and under £400	4*d.* in the pound
£400 and over	4*d.* in the pound for the 1st £400 and 6*d.* for every pound in excess.

A deduction of £30 sterling is made from the taxable amount before levying the tax in cases where the taxable amount is £60 or over, and a further reduction of £10 for each child under seventeen years of age residing with and dependent upon the taxpayer when the taxable amount is under £100, providing such further reduction is claimed by the taxpayer within 30 days of the time when the tax is payable. This provision is an attempt to prevent the tax from bearing unjustly upon persons with larger families.

The tax on rentals was recommended to the legislature as a substitute for the general tax on personalty by the New York Tax Commission of 1871. That commission recommended it as a "building occupancy

[1] "Tasmania," *4 Edward VII*, 1904, chapter 17, Part II.

tax," to be levied as an additional assessment on a sum equal to three times the annual rent or rental value of all the buildings on the land.[1]

In the supplementary report of Professor R. T. Ely to the *Report of the Maryland Tax Commission* of 1888, a tax on the rental values of places of business was proposed as a substitute for the general tax on personal property.[2]

In 1897, the Massachusetts Tax Commission recommended that this tax and the tax on inheritances be substituted for the tax on intangible personal property. The recommendation is supported by several pages of argument.

According to this scheme, the minimum rental to be exempt from taxation was fixed at $400 a year. All rentals of $400 and over were to be taxed at 10 per cent. on the excess of $400. In every case the sum of $400 was to be subtracted from the total amount of rent paid. Thus, a person occupying a house whose rental value was $500 a year would pay a tax of $10, this being 10 per cent. of the excess of rental over $400. When the rent was $600, the tax would be $20; when the rent was $800, the tax would be $40; $1,200, $80, and so on. This tax as proposed by the commission was to be levied upon the occupier of a dwelling and of a dwelling only. Houses or parts of houses that were used for business purposes were in no way to be affected by the tax. It was felt by the commission that houses used in business are sufficiently reached by the tax on real property and by the corporation taxes, so that the attempt to tax them again would expose the taxing authorities to the charge of double taxation, and also cause an undue resistance to the new legislation recommended.[3]

[1] *Report of New York Tax Commission*, 1871, p. 107.

[2] *Report of Maryland Tax Commission*, 1888.

[3] *Report of Massachusetts Tax Commission*, 1897, p. 207. In rejecting the report of the Massachusetts Tax Commission, the House Committee of the General Court said: "The proposed habitation tax cannot, on the whole, be commended as based on a reasonably good criterion of a man's income, because so many other things than a man's income determine the house he lives in. . . . . Even with an earnest desire to avoid hypercritical objections to the carefully thought out schemes proposed in the commissioners' report, anyone who stops and for a moment considers the neighbors in his own street or block will see at once how poor a test the rental value of the different houses is of the comparative wealth of the occupiers. The professional man with a large family will often be found occupying as good a house as the childless millionaire. As a single test, the house rental scheme would inevitably prove not only misleading but often oppressive; and the conclusions based upon it would not be nearly so accurate as those arrived at by the average assessor under the present system, which takes into account not only the house but the whole scale of living of the tax-payer as well as his reputed resources."—*Report of the Industrial Commission*, Vol. XIX, p. 1052.

The latest recommendation is that of the minority of the New York Tax Commission who in 1906 recommended the tax on rentals as a substitute for the general tax on personalty in that state and devoted considerable space to setting forth their plan which has been explained above. It is clear that the tax on rentals is in line with the trend of thought concerning a rational system of taxation.

THE RELATION OF THE ENGLISH CORPUS CHRISTI PLAY TO THE MIDDLE ENGLISH RELIGIOUS LYRIC[1]

By George Coffin Taylor[2]

The historians of the English drama, in seeking to record its origin and development, have almost without exception failed to take notice of the Middle English religious lyric in its relation to the Corpus Christi plays. An occasional note, made at random from time to time, indicates, it is true, that certain writers have been aware that a relation of some sort exists between these two forms of Middle English literature. These notes, however, have for the most part concerned themselves with calling attention to very slight, though interesting, parallels. It is with such similarities, for example, that the observations of Wright,[3] Hone,[4] Courthope,[5] E. Mall[6] and W. A. Craigie[7] have had to do. Davidson,[8] moreover, and Chambers[9] have taken notice in a very general fashion of the fact that the plays are very considerably indebted to the great body of devotional poetry of the day; while Cook[10] has called attention to the frequent occurrence of the *Testament of Christ* in Middle English literature.

One specific type of the mediaeval religious lyric, the *Planctus Mariae*, has for many years attracted considerable attention among European scholars and its relation to the drama has been fairly clearly

[1] Reprinted from *Modern Philology*, Vol. V, pp. 1–16. 1907.

[2] For kindly aid and valuable suggestions, I wish to thank Professor Karl Pietsch, Professor Philip S. Allen and Miss Ethel P. Waxham.

[3] *The Chester Plays*, Vol. II, p. 204 (Shakspere Society, Vol. I).

[4] *Ancient Mysteries Described*, pp. 90 ff.

[5] *History of English Poetry*, Vol. I, pp. 413 ff.

[6] *The Harrowing of Hell.*

[7] *An English Miscellany*, pp. 52 ff.

[8] *Studies in the English Mystery Plays*, p. 170.

[9] *The Mediaeval Stage*, Vol. II, pp. 145 ff.

[10] *The Christ of Cynewulf*, pp. 207 ff.

determined.[1] The other numerous lyric types, most of which like the *planctus* seem to have had their origin in the Latin,[2] and some of which, like the *planctus*, have spread through Europe, have been, so far as I can learn, almost entirely ignored. Taken collectively, these forms doubtless contributed far more extensively to the growth of the cyclic plays in Europe than did the *planctus*, and one of these types alone, *The Testament of Christ* or *The Complaint of Christ to his People*, probably had an effect, all but as important as that of the *planctus* itself, on the growth and expansion of the passion-play.

It was at the suggestion of Professor Manly that I began several years ago to investigate the relation of the general body of lyric poetry in Middle English to the Corpus Christi plays. The field proved fertile. Indeed, so numerous are the types of the lyric which have contributed to the formation of the Corpus Christi plays, and so numerous are the examples which go to make up certain of these types,[3] that I found it necessary for the time being to limit the thoroughgoing investigation to one special type, the *Planctus Mariae*.[4] From a general survey of the field, however, I have been able to arrive at results certain and definite enough to warrant some sort of a statement, and this paper will have attained its object if it succeeds in putting forward some of the more important of the types of the Middle English religious lyric upon which the writers and compilers of the miracle-plays have drawn most freely and extensively.

It will be unnecessary to enter here into an elaborate discussion of the meaning of the term "lyric;" but inasmuch as many of the poems to which reference will be made are not lyrical in any ordinary modern sense, it may be well to say that I have classed as lyric any verse which either in metrical form or in emotional motive seemed in any sense to belong to the lyric categories. I have listed many prayers which are

[1] For references, see "The English *Planctus Mariae*," *Modern Philology*, Vol. IV, pp. 605 ff. A thesis by Thien, *Ueber die englischen Marienklagen*, was published several months before my article on the *Planctus* appeared. My article, which had been in the hands of the editors of *Modern Philology* for almost two years, was being printed when I secured a copy of Thien's thesis.

[2] Unfortunately, during the last few months, *Analecta hymnica* (Dreves) has been inaccessible to me. It doubtless contains many other Latin prototypes of the Middle English lyrics than those which I cite in this paper.

[3] *The Testament of Christ* and *The Hail Mary*.

[4] See "The English *Planctus Mariae*," *Modern Philology*, Vol. IV, pp. 605 ff.

very slightly lyrical, if lyrical at all in any sense, and very occasionally I have paused to comment incidentally upon didactic types such as the *Ten Commandments*.

Perhaps the non-dramatic type most frequently incorporated into the plays is the general prayer addressed, as the occasion may serve, to God the Father, Christ the Son and very frequently also to the Virgin Mary. There are thousands of these prayers to be found in the devotional poetry of the day, and hundreds in the plays.[1] It is fairly certain that many of these were taken over as ready-made lyrics by the play-writers and adapted to dramatic purposes. Thus the celebrated mediaeval Latin hymn, *Veni creator, spiritus*,[2] seems to have been taken over bodily by Chester in *The Emission of the Holy Ghost*,[3] and probably has escaped notice up to the time, mainly because it is so abominably translated.[4] Of the prayers to Christ[5] two types especially have exerted a very marked and definite influence upon the drama. Of both types there are scores in Middle English literature. The one is the prayer of a repentant sinner, lamenting his past offenses;[6] the other consists of that class of prayers in which the sufferings and bodily wounds of

[1] *Chester Plays* (ed. Thomas Wright, Shaks. Soc., Vol. I), Vol. I, pp. 97, 162; Vol. II, pp. 159, 160, 179; *York Mystery Plays* (ed. Miss Lucy Toulmin Smith), pp. 3, 36, 61, 100, 108, 433; *The Towneley Plays* (ed. A. W. Pollard, EETS), pp. 3, 23, 40, 99, 195; *Coventry Mysteries* (ed. J. O. Halliwell, Shaks. Soc., Vol. II), pp. 40, 49, 57, 104, 380. For examples of prayers of a somewhat similar nature, see *Minor Poems of the Vernon MS* (EETS), Vol. I, pp. 26, 145, 149, 355; *An Old English Miscellany* (EETS), p. 100; *Religious Pieces* (EETS), p. 59; *Eng. Stud.*, Vol. IX, p. 49; *Anglia*, Vol. I, p. 67; *Specimens of Lyric Poetry* (Percy Soc., Vol. IV), p. 49; *Richard Rolle of Hampole* (ed. Horstmann, "Yorkshire Writers"), Vol. I, pp. 363 ff.; *Bannatyne MS* (pr. for the Hunterian Club), Vol. I, pp. 84, 107.

[2] See *Das deutsche Kirchenlied* (Wackernagel), Vol. I, p. 75. See further, *Minor Poems of V. MS*, Vol. I, p. 43; *Hymni Latini* (Mone), Vol. I, pp. 241 ff.

[3] *Chester*, Vol. II, pp. 127 ff. In the Hegge *Mary's Betrothment* (p. 93), the stage directions order the singing of this hymn, but the existing text does not contain it. In the York *Descent of the Holy Spirit* (p. 469) we are told that the angels sang this hymn to Mary.

[4] See for dramatic customs in connection with the hymn, Chambers, *The Med. Stage*, Vol. II, p. 66. See for parallels, Appendix of the present discussion, pp. 16 f.; anyone who may desire to verify the parallels may consult the Appendix to the present article published by me in *Modern Philology*, Vol. V, pp. 16 ff. 1907.

[5] *Chester*, Vol. II, pp. 99, 101 ff.; *York*, pp. 177, 212, 368, 424 ff., 504; *Town.*, pp. 325 ff., 340 ff.; *Cov.*, pp. 223, 356, 403. For prayers to Christ of various kinds, see *Minor Poems of the V. MS*, Vol. I, pp. 37, 45, 48, 131 ff., 154, 332; Vol. II, 449, 451, 464 ff.; *Richard Rolle of Hampole* ("Yorkshire Writers"), Vol. I, pp. 72 ff., 363 ff.; *William of Shoreham* (EETS), pp. 79 ff., *Gude and Godlie Ballatis* (Scot. T. Soc.), pp. 21, 24, 62, 64, 73 ff.; *The Poems of Dunbar*, Vol. II (Scot. T. Soc.), p. 65; *Political, Religious, and Love Poems*, re-ed Furnivall (EETS), pp. 123 ff.; *Anglia*, Vol. V, Anzeiger, p. 119; Vol. XII, p. 595; *Eng. Stud.*, Vol. VIII pp. 255 ff.; Vol. X, pp. 232 ff.; *Herrigs Archiv*, Vol. XCVIII, p. 129.

[6] *Chester*, Vol. II, pp. 6, 180 ff., 192 ff.; *York*, pp. 30 ff., 39, 138, 174, 311; *Town.*, pp. 343, 351 ff.; *Minor Poems of the V. MS*, Vol. I, pp. 48 ff.; Vol. II, pp. 696, 785 ff.; *Rich. R. of Hampole*, Vol. I, pp. 74 ff., 368 ff.; *Polit., Relig. and Love Poems*, pp. 123 ff.; *Hymns to V. and C.* (EETS), pp. 95 ff.; *Reliquiae Antiquae*,

Jesus are recounted in detail as cause for lamentation.[1] No single motive in the devotional poetry of the day seems to have been turned to literary uses so frequently and no motive enables the writers of the time to rise to more fervid and more moving heights of lyric poetry. It would seem that this motive has been taken over from the *Testament of Christ* poems, which will be considered at some length below. An exceptionally conventional form of these lyrical prayers is characterized both in the plays and in the independent lyrics by the initial phrase "When I think."[2] Another very conventional passage which occurs in these prayers to Jesus and has made its way from the lyric over to the drama is characterized by the constant repetition of the phrase "Mercy Jesus."[3]

Perhaps the most highly conventional of all the conventional forms of address to Christ is the *Hail Jesus*, a prayer in which oftentimes almost every line begins with this formula, followed by synonyms indicating in a fashion the different qualities and characteristics of the Savior. There are numerous examples of this form in the drama; it appears most frequently in the Christmas plays and constitutes a very large portion of the body of the play in Chester, York and Towneley.[4] It

Vol. I, pp. 261 ff.; Vol. II, pp. 119 ff., 190 ff., 226; *Anglia*, Vol. XXVI, pp. 157, 160. The cries of lost souls who are being carried away to hell might very well be considered in connection with the prayers of the repentant sinners, but more fittingly deserve consideration in connection with the many lyrical poems which have found their way into the judgment-plays, which I consider below.

[1] In the plays these lyrics in the majority of cases are characterized by some one of the stanzas or lines beginning with the word "Alas!" Sometimes also this is the case with the independent lyrics. See further, *Chester*, Vol. II, pp. 53, 95, 101; *York*, pp. 260, 341 ff., 406 ff., 410, 421 ff., 456, 480 ff.; *Town.*, pp. 277, 316 fi. 325 ff., 358; *Cov.*, pp. 316, 331, 355 ff., 360; *Minor Poems of the V. MS*, Vol. I, pp. 29, 37, 47, 302, 384, 404, 425 ff.; Vol. II, pp. 452 ff., 471 ff.; *Legends of the Holy Rood* (EETS), pp. 150, 194 ff., 217 ff., 222; *Rich. R. of Hampole*, Vol. I, pp. 76 ff., 369 ff.; *William of Shoreham's Poems* (EETS), pp. 79 ff.; *Spec. of Lyric Poetry* (Percy Soc., Vol. IV), pp. 62 ff., 83, 86, 111 ff.; *Eng. Stud.*, Vol. VII, pp. 454, 468; Vol. IX, p. 45; *Anglia*, Vol. XII, pp. 595 ff.; Vol. XXVI, pp. 263 ff.; *An Old Eng. Misc.*, pp. 38, 140, 197; *The Bann. MS*, Vol. I, pp. 77, 85, 90, 103, 106. Especially interesting is the passage of this kind to be found in *The Lamentation of Mary Magdalene* (ed. Bertha M. Skeat), as the same kind of passage is so frequently put into her mouth in the miracle-plays. See further *Hymni Latini* (Mone), Vol. I, pp. 121 ff., 131 ff., 392 ff.

[2] *York*, p. 452, l. 116; *Town.*, pp. 316, 327, 328; *Spec. of Lyric Poetry* (Percy Soc., Vol. IV), p. 83, *Rich. R. of Hampole*, Vol. I, p. 78; *Hymni Latini* (Mone), Vol. I, pp. 415 ff. For parallels, see Appendix, pp. 17 f.

[3] *York*, pp. 424, 489; *Town.*, p. 351; *Herrigs Archiv*, Vol. CVI, pp. 60 f. For parallel passages, see Appendix, pp. 29 f.

[4] *Chester*, Vol. I, pp. 104 ff., 167 ff.; *York*, pp. 114 ff., 135 ff., 216 ff., 444 ff.; *Town.*, pp. 114 ff., 139 ff., 157 ff.; *Cov.*, pp. 158 ff., 168 ff. See also *Rich. R. of Hampole*, Vol. I, pp. 78 ff.; *Minor Poems of the V. MS*, Vol. I, pp. 24 ff.; Lydgate's *Nightingale and Other Poems* (ed. Glauning, EETS), pp. 26 ff.; *The Bann. MS*, Vol. I, pp. 72 ff., 84 ff. See further, *Hymni Latini* (Mone), Vol. I, pp. 156 ff. See Appendix, p. 18.

may possibly not be amiss to consider as variations of the above lyrical form the *Welcome* and *Farewell* lyrics sometimes addressed to Jesus, sometimes to Mary, in which "Welcome" or "Farewell" are substituted for "Hail;" they seem to be modeled throughout upon the *Hail* poems.[1] Very similar in form and general treatment to the *Hail Jesus* is the *Hail Mary.*[2] Serving about the same purpose in the plays is the prayer which begins with "Come" instead of "Hail,"[3] and which very probably belongs to the class of Latin lyrics represented by *Veni praecelsa domina.*[4] The *Hail* lyrics and their variations may all have been the development of one line in the annunciation-lyrics, spoken by Gabriel, "Hail Mary."[5] Of the general prayers and hymns to Mary there are in the poetry of the day thousands,[6] and in the drama some few.[7] It is especially interesting to find, however, that two of the most highly conventionalized of all the hymns to Mary have worked their way into the plays. The one is the

[1] The *Welcome* lyrics are to be found in *Chester*, Vol. I, pp. 194 ff.; Vol. II, pp. 2 ff.; *York*, pp. 443, 489; *Cov.*, pp. 176, 347; *The Pageant of the Shearmen and Taylors* (Manly, *Pre-S. Dr.*), ll. 699 ff. See also for this form of address applied to persons other than Christ, *The Digby Plays* (ed. Furnivall, EETS), pp. 18, 128. They are to be found as independent lyrics in *The Minor Poems of Lydgate* (Percy Soc., Vol. II), p. 10; *Christmas Carols* (Percy Soc., Vol. IV), pp. 4, 53, 57; *Songs and Carols* (Percy Soc., Vol. XXIII), p. 43; *The Bann. MS*, Vol. I, p. 255. The specimen printed in Percy Soc., Vol. XXIII, p. 43, suggests that this class of lyrics may have had its origin in some of the pagan Germanic folk-customs.

The *Farewell* lyrics are to be found in *Chester*, Vol. I, p. 171; *York*, pp. 447, 487; *Town.*, p. 203; *Cov.*, pp. 102, 143, 160, 347. See *The Lamentation of Mary Magdalene*, ed. Bertha M. Skeat. See also *Songs and Carols* (Percy Soc., Vol. XXIII), p. 57, and *The Bann. MS*, Vol. II, pp. 645 ff., where it is used as a form of address to others than Christ. See for parallel passages, Appendix, pp. 19 ff.

[2] *York*, pp. 473, 484 ff., 492; *Cov.*, pp. 176, 387, 389, 391; *Minor Poems of the V. MS*, Vol. I, pp. 49 ff., 121 ff.; *Polit., Relig. and Love Poems* (1st ed., EETS), pp. 81 ff., 145 ff., 174 ff.; *Wm. of Shoreham* (EETS), pp. 127 ff.; *Hymns to V. and C.*, pp. 4 ff.; *Songs and Carols* (Percy Soc., Vol. XXIII), p. 80; *Chaucerian and Other Poems* (ed. Skeat), p. 275; *Rel. Ant.*, Vol. II, pp. 174; *Anglia*, Vol. XXVI, pp. 164 ff.; Vol. XXVII, pp. 321 ff.; *Herrigs Archiv*, Vol. LXXXIX, pp. 183 ff. For the use of this lyric as a form of address to characters other than Christ and Mary, see *The Digby Plays*, pp. 69, 103 ff., 126 ff. For French forms see Gröber, *Grundriss der romanischen Philologie*, Vol. II, Part I, pp. 974 ff. For Latin lyrics of this type see *Das deutsche Kirchenlied* (Wackernagel), Vol. I, pp. 125 ff., 169 ff., 172 ff., 190 ff.; *Hymni Latini* (Mone), Vol. II, pp. 5 ff.

[3] *York*, pp. 445, 484.

[4] *Das deutsche Kirch.* (Wackernagel), Vol. I, p. 246; *Hymni Latini* (Mone), Vol. II, pp. 125 ff.; see also *Hymni Latini*, Vol. I, p. 247, and *Piae Cantiones* (Klemming), p. 176. See Appendix, p. 21.

[5] See the Latin lyric, *Das deutsche Kirch.*, Vol. I, p. 116; see English lyrics, *An Old Eng. Misc.*, p. 100; *Minor Poems of V. MS*, Vol. I, p. 4; *Eng. Stud.*, Vol. XIV, p. 401; *Chester*, Vol. I, p. 94; *York*, p. 98; *Town.*, p. 88; *Cov.*, p. 112.

[6] See *Das deutsche Kirch.*, Vol. I, pp. 47, 82, 109 ff.; *Rel. Ant.*, Vol. I, pp. 22, 89, 102, 169, 235, 274; Vol. II, pp. 120, 212, 228 ff.; *Anglia*, Vol. XXVI, p. 190.

[7] *York*, pp. 101, 476, 492, 494 ff.; *Cov.*, pp. 116, 128, 154. Professor Manly has suggested that many more were present at one time in the body of the plays, but that most of them were cut out at the time when Mary-worship fell into disfavor in England.

lyric which plays fancifully with the individual letters of Mary's name;[1] the other is one of the most facetious and popular of the religious lyrics current during the Middle Ages, *The Five Joys of Mary*, sometimes also written in the form, *The Seven, Nine, and Fifteen Joys of Mary*. It is in the form of the *Five Joys* that it is found in the *York Plays*.[2] This form of the lyric, however, affected the drama most extensively when at Brussels it was given the dignity of a separate play.[3]

Of the many types of prayers and complaints in Middle English none is characterized by a more peculiar and striking tone than that in which the prayer is made to suit the especial needs of an old man.[4] In these lyrics the speaker sometimes laments the sins of his youth, complains of his decrepit condition, and describes in detail the physical decay which accompanies old age. Many of these are of the nature of dramatic monologues and readily adapt themselves to dramatic treatment. It is difficult to read the speeches of characters in the plays, such as Noah, Joseph and Simeon, without feeling that they were in a very definite sense influenced by these complaints.[5] And the humorous treatment of Joseph in the Corpus Christi plays, especially in Chester and Coventry,[6]

[1] See *Cov.*, p. 88; *Herrigs Archiv*, Vol. CIX, p. 64; *Hymni Latini* (Mone), Vol. II, pp. 94 f. See also the prayer to Jesus (Percy Soc., Vol. II, p. 278). See for parallel passages, Appendix p. 29.

[2] Pp. 493 ff. See also for Latin forms, *Das deutsche Kirch.*, Vol. I, pp. 150 ff.; *Hymni Latini* (Mone), Vol. II, pp. 161 ff.; *Rich. R. of Hamp.*, Vol. I, pp. 408 ff.; and for English forms, *Minor Poems of V. MS*, Vol. I, pp. 25 ff., 31 ff., 133 ff.; *Wm. of Shoreham*, p. 117; *An Old Eng. Misc.*, p. 87; *Spec. of Lyric Poetry* (Percy Soc., Vol. IV), pp. 54 ff., 94 ff.; *Christmas Carols* (P. Soc., Vol. IV), pp. 7 f.; *Songs and Carols* (P. Soc., Vol. XXIII), pp. 68 ff.; Böddeker, *Altenglische Dichtung*, p. 218; *Anglia*, Vol. XXVI, pp. 164, 226, 232, 242, 257; *Rel. Ant.*, Vol. I, p. 48; Mätzner's *Altenglische Sprachproben*, pp. 51; *Herrigs Archiv*, Vol. LXXXIX, pp. 275, 282; Vol. CIX, pp. 48, 49; *Cursor Mundi* (EETS), Parts V, VI, p. 1468. See further Gröber, *Grundriss der romanischen Philologie*, p. 973. For parallel passages, see Appendix, p. 22.

[3] CREIZENACH, Vol. I, p. 340; CHAMBERS, Vol. II, p. 87.

[4] *Rel. Ant.*, Vol. I, pp. 119, 197; Vol. II, p. 210; *Hymns to V. and C.*, pp. 36, 83; *Anglia*, Vol. III, p. 279; *The Minor Poems of Lydgate* (Percy Soc., Vol. II), pp. 240, 254; *Spec. of Relig. Poetry* (P. Soc., Vol. IV), p. 47; *Bann. MS*, Vol. II, pp. 457, 781; *The Poetical Works of Skelton* (ed. Dyce), Vol. I, pp. 2 ff. Sometimes the passage simply describes the condition of the body in old age, without taking the form of a complaint. See *The Minor Poems of Lydgate* (Percy Soc., Vol. II), p. 30; *The Pricke of Conscience* (ed. R. Morris), p. 22; *Hymns to V. and C.*, p. 79; *Minor Poems of Vernon MS*, Vol. II, pp. 446 ff.; *Twenty-six Polit. Poems* (EETS), p. 138. The best known of these is perhaps "Maximon," *Rel. Ant.*, Vol. I, pp. 119 ff.; pr. also in *Anglia*, Vol. III, pp. 279 ff., and in Böddeker, *Alteng. Dicht.*, pp. 244 ff.

[5] *Chester*, Vol. I, pp. 98, 139, 189; *York*, pp. 43, 102, 138, 436; *Town.*, pp. 25, 161, 181 ff.; *Cov.*, pp. 96, 118; see also *Nice Wanton*, Manly's *Pre-S. Dr.*, Vol. I, ll. 260 ff., for the same type of speech in the mouth of an old woman. For parallel passages, see Appendix, pp. 22 ff.

[6] *Chester*, Vol. I, pp. 98, 138 ff.; *Cov.*, pp. 117 ff., 131 ff., 145 ff.

may, in fact, be due to the eternal ridiculing of old men with young wives in the semi-religious lyrics.[1]

Middle English poetry contains an exceedingly rich body of Christmas songs.[2] One might except to find that these had exerted a considerable influence upon the English Christmas plays. And there are, it is true, a few fragments of what may have once been Christmas lyrics.[3] But if there were ever complete lyrics at the beginnings of the English shepherds plays, or at those points in the plays where the angels first address the shepherds—points at which we might expect to find them—they have been crowded out by material of another sort. In the *Pageant of the Shearmen and Taylors*, there are, of the three songs appended at the end, two, Nos. I and III, which bear unmistakable evidence of being Christmas lyrics.[4] There is also another Christmas lyric which very evidently resembles those portions of the Christmas plays in which the shepherds make their offerings to Christ.[5] In this case, however, it is the lyric which has been influenced by the miracle plays, rather than the reverse.

Almost as widespread as the *Christmas Carol*, and far more uniform in its type, is the *Testament of Christ*, termed variously the *Lament of the Redeemer*, *Christ's Charter*, and *Christ's Complaint*.[6] Here again, as

[1] *Christmas Carols* (Percy Soc., Vol. IV), p. 52; Hone's *Ancient Mysteries*, pp. 90 ff. See for the treatment of this theme in the fourth-century Greek homiletic writings, Cook, *Journal of Germanic Philology*, Vol. IV, pp. 421 ff.

[2] See *Christmas Carols* (Percy Soc., Vol. IV); *Songs and Carols* (Percy Soc., Vol. XXIII); *Anglia*, Vol. XXVI, pp. 189, 196, 231, 235, 253, 260, 265, 268, 271, 274, 279. A complete list of them would make a small-sized book of bibliography in itself. See also, for numerous Latin songs of much the same sort, *Das deutsche Kirchenlied*, Vol. I, pp. 198 ff.

[3] Town., *Shepherd's Play*, I, ll. 295 ff.; II, ll. 638 ff.; *The Adoration of the Shepherds*, ll. 1–13. See also *The Pageant of the Shearmen and Taylors* (Manly, *Pre-S. Dr.*), ll. 435 ff.

[4] Manly, *Pre-S. Drama*, Vol. I, pp. 151 ff.;ed. also by Craig, *Two Coventry Corpus Christi Plays* (EETS), p. 32. Compare with No. 1, *Rel. Ant.*, Vol. II, p. 76; for the same carol see also *Songs and Carols* (Percy Soc., Vol. XXIII), p. 12, and *Anglia*, Vol. XXVI, pp. 250 ff.; compare with No. III the lyric No. LXXIII of the Baliol MS, 354, *Anglia*, Vol. XXVI, pp. 237 ff. See Appendix, p. 23, for parallels.

[5] *Anglia*, Vol. XXVI, pp. 243 ff., Poem No. LXXXII, stanzas 7, 8, 9. See Appendix, pp. 23 ff., for parallels.

[6] Cook, in *The Christ of Cynewulf*, pp. 208 ff., called attention to the frequent occurrence of this form in English and in other literatures, citing at the same time examples of its occurrence in the miracle-plays and inquiring into its origin. I add the following references: *Chester*, Vol. II, pp. 190 ff.; *York*, pp. 363, 423, 450, 454; *Town.*, pp. 265 ff., 341; *Cov.*, pp. 207, 325, 329, 346; *Minor Poems of V. MS*, Vol. I, pp. 259, 435; Vol. II, pp. 462, 625, 659; *Pricke of Conscience*, pp. 141, 145; *An Old Eng. Misc.* (EETS), pp. 81, 231; *Herrigs Archiv*, Vol. CVI, pp. 53, 62 (similar to version by Skelton, pp. 141 ff.), 69 ff.; *Cursor Mundi*, pp. 1644 ff.; *Polit., Relig. and Love Poems* (re-ed. by Furnivall for EETS), pp. 141 ff., 182 ff., 190 ff., 254 ff., 262 ff., 276 ff.; *Hymns to V. and C.* (EETS), pp. 124 ff.; *The Lamentation of Souls* (ed. Lumby with *Be Domes Daege*), ll. 35 ff. (EETS); *Twenty-six Polit. Poems* (EETS), pp. 41 ff., 76 ff., 85 ff.; *The Minor Poems*

in the case of the *Complaints of an Old Man*, we have an instance of a lyrical form which is in itself essentially of the nature of a dramatic monologue; and the treatment of this theme in the drama and in the independent poems differs scarcely at all, the independent poems sometimes it is true growing to far larger proportions than they ever do in the drama. It seems highly probable that in many cases the independent lyric has been inserted into the drama with little or no change. In Towneley[1] this, it would seem, has certainly happened. Skelton's lyric on the same theme,[2] if Skelton's it may be called, is almost word for word and rhyme for rhyme similar to Towneley. It is difficult to say how much this form had to do with the growth and development of the passion-plays. Historians of the drama have had so much to say about the *Planctus Mariae* in its relation to the passion-plays that they have failed to take special notice of this lyrical form, about as widespread and popular in the Middle Ages as the *planctus*, if not more so. The form, however, may have had more to do with the initial stages of development of the passion-play than it is given credit for. It is barely possible that it is to some form of this Lament that de Douhet refers when seeking to explain the origin of the passion-play.[3] In the English passion-play there is no more evidence that the *planctus* was the germ or starting-point of the passion-plays than there is for the *Christ's Testament.*[4] In the German Tyrol[5] and Alsfelder[6] passion-plays this passage follows very closely the Latin hymn form, in which is found the First Lesson

of Lydgate (Percy Soc., Vol. II), pp. 259 ff.; *Songs and Carols* (P. Soc., Vol. XXIII), pp. 19 ff., 46; *Wyt and Science and Early Poetical Miscellanies* (Shaks. Soc., Vol. II), pp. 68 ff.; *Bann. MS*, Vol. I, pp. 82 ff., 96, 103, 112 ff.; Lydgate's *Two Nightingale Poems* (EETS), pp. 21 ff.; *Poetical Works of Skelton*, Vol. I, pp. 141, 144; *The Assumption of Our Lady* (re-ed. by G. H. McKnight, EETS), pp. 123 ff.; *Eng. Stud.*, Vol. XXI, pp. 207 ff.; *Rel. Ant.*, Vol. II, pp. 119, 225; *Anglia*, Vol. III, pp. 550 ff.; Vol. XXVI, pp. 246, 248 ff., 255; *Alteng. Dicht.* (Böddeker), pp. 271 ff.; *The New Nut Brown Maid* ("Early Popular Poetry," ed. Hazlitt, Vol. III), pp. 2 ff.; *Rich. R. of Hampole*, Vol. I, p. 88; Vol. II, pp. 16 ff., 457 ff. See also Thien, *Ueber die englischen Marienklagen* (Kiel, 1906), p. 82. Compare *Hymni Latini* (Mone), Vol. I, pp. 396 f., and also *Carmina Burana* (Schmeller, 1904), p. 29.

[1] *The Resurrection of the Lord*, ll. 262 ff.

[2] *The Poetical Works of Skelton* (ed. Dyce), Vol. I, pp. 144 ff. See Appendix, pp. 26 ff., for parallel passages.

[3] *Dictionnaire des mystères*, pp. 633 ff.

[4] See "The English *Planctus Mariae*," *Modern Philology*, Vol. IV, pp. 632 ff.

[5] WACKERNELL, *Altdeutsche Passionsspiele aus Tirol*, pp. 127 ff.

[6] "Das Drama des Mittelalters," *Deutsche Nat.-Litteratur*, Vol. III, pp. 764 ff.

for the First Nocturn for Good Friday.[1] In both cases, moreover, the initial lines are in the original Latin, as if at one time the entire Latin hymn had had its place in the earliest passion-plays. So far as I have been able to discover, it seems by no means certain that the *planctus* was dramatized any earlier than the *Testament of Christ.*

Any investigation of the resurrection-lyrics, some of which are still retained in many of the miracle-plays[2] which treat the events following the crucifixion, would naturally lead us back to the question of the liturgical origins of the Easter-play. With that question this paper is not directly concerned. There are, however, some few of these lyrics in the plays which may be the result of the playwrights having drawn upon the English independent resurrection-lyrics,[3] rather than the result of the retention and gradual development of the original resurrection-hymns of the liturgical drama.

From the point of view of today those lyrics which deal with the general theme of the *Life of Man*[4] in a semi-secular, semi-religious tone are by far the most interesting of all the various classes with which we are concerned in this discussion. The writers of Middle English verse never tire of discoursing about the briefness, the changeableness of life, the transitoriness and worthlessness of all earthly things, often stopping to describe in detail the repulsiveness of the human body, and almost as

[1] For other places in which it is employed in the Sarum Use, see Cook, *The Christ of Cynewulf*, p. 208.

[2] *York*, p. 424; *Town.*, pp. 324, 344 ff., 355 ff., 362; *Cov.*, pp. 348, 356 ff., 362 ff., 367 ff., 371 ff., 375 ff.

[3] *The Gude and Godlie Ballatis*, pp. 47; *The Bann. MS*, Vol. I, pp. 93, 95. For poems of the same kind with refrains as in *Cov.*, pp. 375 ff., see *The Bann. MS*, pp. 92 ff.; *Polit., Relig. and Love Poems* (EETS), pp. 210 ff.; *Chester*, Vol. II "Notes," pp. 204 ff. The last three examples are in reality *Planctus Mariae*, influenced in form by the resurrection-lyric. For examples of Latin lyrics of a somewhat similar type, see Wackernagel, *Das deutsche Kirchenlied*, Vol. I, pp. 175 ff., 218, 242 ff.

[4] For lyrics of this general type, see *Lydgate's Minor Poems* (Percy Soc., Vol. II), pp. 74 ff., 193; *Spec. of Lyric Poetry* (P. Soc., Vol. IV), pp. 23, 47, 60, 101; *Religious Songs* (P. Soc., Vol. XI), pp. 64 ff.; *Songs and Carols* (P. Soc., Vol. XXIII), pp. 4 ff.; *Rel. Ant.*, Vol. I, pp. 26, 138, 160, 234, 235, 261; *The Minor Poems of Lydgate* (P. Soc., Vol. II), pp. 24, 124, 229; *Early Pop. Poetry*, Vol. III, p. 40; *Bann. MS*, Vol. I, pp. 37, 55, 127 ff., 131, 137, 152 ff., 155 ff., 201, 209 ff., 308, 321, 329; Vol. II, pp. 759 ff.; *Anglia*, Vol. I, pp. 285, 291; Vol. II, p. 71; Vol. XXVI, pp. 141 ff., 158, 167, 185, 197 ff., 207; *Minor Poems of V. MS* (EETS), Vol. I, pp. 335, 343; Vol. II, pp. 512, 667, 672, 674 ff., 686, 692, 715, 726 ff., 730, 740 ff.; *Polit Relig. and Love Poems* (re-ed. EETS), pp. 255, 263; *Twenty-six Polit. Poems* (EETS), p. 113; *Wm. of Shoreham* (EETS), p. 1; *Religious Pieces* (EETS), p. 79; *Hymns to V. and C.* (EETS), pp. 39, 58, 80, 83, 86; *An Old Eng Misc.*, pp. 65, 69, 93, 156, 161, 170; *Chaucerian and Other Pieces* (ed. Skeat), pp. 291 ff., 449; *Herrigs Archiv*, Vol. CIX, p. 46; *Eng. Stud.*, Vol. XXI, p. 201; *The Poetical Works of Skelton* (ed. Dyce), Vol. I, p. 2; *The Gude and Godlie Ballatis*, p. 30; *The Poems of Dunbar* (Scot. T. S.), Vol. II, pp. 74 ff., 110, 226, 232, 244; *Rich. Rolle of Hampole*, Vol. I, pp. 73, 77, 367 ff.; *The Pricke of Conscience* (ed. Morris), pp. 39, 52.

often, using this text as a sermon, ending the poem by calling upon us to amend our lives and repent while there is yet time. The best-known and in a literary way the most effective form of this lyric is the *Ubi Sunt*, immortalized by Villon and Thomas de Hales, in which the writer inquires where the great and famous of the world are all gone. With this lyric we are not concerned here; its influence on the Corpus Christi play is hardly to be detected, though it later makes its appearance in Skelton's *Magnyfycence*, later still at the end of *The Disobedient Child*, and finally in Shakespeare's *Richard III*.[1] Other types of the *Life of Man* lyric have, however, exercised an influence upon these plays which, though slight, is marked and striking. In the Towneley *Shepherd Plays*[2] appears the form which emphasizes the variableness of life in the conventional phrases, "Now in, now out;"[3] in the Towneley *Shepherd's Play*, II,[4] the briefness of life is especially emphasized.[5] In the Towneley *Judgment*[6] there is a suggestion of the *Ubi Sunt* which calls to mind rather the Anglo-Saxon[7] form than the the highly conventionalized and fixed form of Middle English. In the Towneley *Lazarus*[8] there is a lyrical passage which reminds one of the *Ubi Sunt* in theme, but differs from it very considerably in its type—a type which is about as common in Middle English as the better-known *Ubi Sunt*.[9] There is, moreover, a longer lyric in the *Lazarus* which is marked by the refrain

[1] Act IV, sc. iv, ll. 91 ff.

[2] I, ll. 1 ff., and II, ll. 60 ff.

[3] *The Sayings of St. Bernard* (*Minor Poems of Vernon MS*, Vol. II), pp. 513, 692, and elsewhere in *The Sayings of Bernard;* Böddeker, *Alteng. Dicht.*, p. 195; *Eng. Stud.*, Vol. IX, p. 441; *Herrigs Archiv*, Vol. CIX, p. 42; *Pricke of Conscience*, pp. 40 ff.; *The Poems of Dunbar* (STS), Vol. II, p. 244. See Appendix, p. 29, for parallel passages.

[4] Ll. 120 ff.; see also *Chester*, Vol. II, p. 165.

[5] *Minor Poems of V. MS*, Vol. II, p. 692; *Wyt and Science and Early Poetical Miscellanies* (Shaks. Soc., Vol. II), pp. 110 ff.; *Anglia*, Vol. XXVI, pp. 192 ff.; *Rich. Rolle of Hampole*, Vol. II, p. 457; *Pricke of Cons.*, pp. 20 ff.

[6] Ll. 550, 551.

[7] *The Wanderer* (*Bibl. der angelsächs. Poesie*, Wülcker, ll. 92 ff.); see also a somewhat similar form in *Body and Soul* poems.

[8] Ll. 111 ff.

[9] *Bann. MS*, Vol. I, p. 154; *Spec. of L. P.* (Percy Soc., Vol. IV), p. 87; *Religious Songs* (P. Soc., Vol. XI), p. 63; for Old French forms see *Satirical Songs and Poems on Costume* (P. Soc., Vol. XXVII), p. 33; *Eng. Stud.*, Vol. XIV, p. 186; *Relig. Pieces* (EETS), p. 81; *An Old Eng. Misc.* (EETS), pp. 91, 94, 157; *Minor Poems of V. MS*, Vol. II, pp. 676, 678. Compare *Hymni Latini* (Mone), Vol. I, p. 398. For parallels see Appendix, p. 30.

"Amend thee man whilst thou may."[1] Poems of a very similar nature, most of them characterized by almost the same refrain, are abundant in the general body of lyric poetry of the day;[2] they too have their Latin prototype. Within this lyric another form makes its appearance—a form which the *verse* homilist is fond of using when preaching his sermons of the frightening sort. It reads here, "Thynk thou on the dredefull day," and, "Thynke thou farys as dothe the wynde."[3] Similar passages occur in many poems of the day.[4] In the *Lazarus* also the poet follows the body of man after death and describes it in detail.[5] The passage calls to mind scores of poems which treat the same theme, from some of which it very probably borrowed many a phrase and line. The most remarkable line which has worked its way into this passage is, "The Royfe of your hall,/your naked nose shall touche," which is present in almost all of the *Body and Soul* poems, and sometimes in the *Long Life* poems.[6]

The judgment-plays, among the very latest developments of the English cyclic plays, afford on the whole the most interesting examples of the influence of the independent poems upon the upbuilding of the cyclic dramas. It is impossible, perhaps, to arrive at a just estimate of their origin and development without entering into a thoroughgoing

[1] *Town.*, p. 392, ll. 174 ff.

[2] *Polit., Relig. and Love Poems*, pp. 215 ff.; *An Old Eng. Misc.*, pp. 62, 78; *Minor Poems of V. MS*, Vol. II, pp. 668, 672, 725 ff., 727 ff., 730 ff.; *Twenty-six Polit. and Other Poems*, pp. 60 ff.; *Anglia*, Vol. I, p. 411; Vol. II, p. 71; Vol. XXVI, p. 233; *Minor Poems of Lydgate* (Percy Soc., Vol. II), pp. 228 ff.; the poem is far too similar to other poems of this type to be called Lydgate's in any proper sense; *Religious Songs* (P. Soc., Vol. XI), pp. 63 ff.; *Songs and Carols* (P. Soc., Vol. XXIII), pp. 4, 29, 37, 45; *Bann. MS*, Vol. I, pp. 97, 103, 127, 129, 133, 138, 145, 201, 203; *Rich. Rolle of Hampole*, Vol. I, pp. 73, 76; *Herrigs Archiv*, Vol. CVI, pp 275 ff. For Latin poems of somewhat similar refrain, see *Hymni Latini* (Mone), Vol. I, pp. 395 f.; *Cantiones* (Klemming), pp. 16 ff. See Appendix, pp. 32 ff., for parallel passages.

[3] Ll. 176, 178.

[4] *Spec. of Lyric Poetry* (Percy Soc., Vol. VI); *Religious Songs* (P. Soc., Vol. XI), p. 71; printed also in *An Old Eng. Misc.*, p. 170; *Minor Poems of the V. MS*, Vol. II, p. 477; *Rich. Rolle of Hamp.*, Vol. I, p. 156; *Pricke of Cons.*, p. 73; *Rel. Ant.*, Vol. I, p. 139. For Latin form, see *Latin Hymns* (March), p. 121. See Appendix, pp. 33 ff., for parallel passages.

[5] *Town.*, pp. 391 ff.

[6] Especially is it noticeable in the Anglo-Saxon specimen printed in *Anglia*, Vol. V, p. 289; *Eng. Stud.*, Vol. XIV, p. 184, ll. 153 ff. For other passages very similar to the *Lazarus* description of what we come to after death, see *Rel. Ant.*, Vol. I, p. 139; *The Poet. Works of Skelton* (ed. Dyce), Vol. I, p. 19; *Anglia*, Vol. XXVII, p. 309; *Rich. Rolle of Hamp.*, Vol. I, pp. 73, 367 ff., 372; *Pricke of Cons.*, pp. 13 ff.; *Wm. of Shoreham*, p. 32; *An Old Eng. Misc.*, pp. 78, 92, 172 ff., 178; *Minor P. of V. MS*, Vol. I, pp. 270,, 335 343; Vol. II, pp. 511 ff. Similar passages may be found in almost any of the *Body and Soul* poems. See for parallel passages, Appendix, p. 33.

investigation of the Doomsday literature of the Middle Ages; and that of course lies beyond the limits of this study. It seems possible, however, to get a notion of some sort as to their development in English. The York judgment-play seems to represent the most primitive form of the four plays in English. Its structure is fairly simple: an opening speech by God recounting the wickedness of mankind, brief praise of God by the angels, the cries of the good and bad souls as they awake, Christ's descent to earth and brief talk with his angels, brief speeches of the devils, Christ's *Complaint* or *Testament*, his division of the good and bad souls, their questions and replies to Christ, Christ's blessing of the good souls and damning of the bad—this is about the plot of the play. One set of incidents in this play we find in the judgment-plays of Chester, Towneley, and Coventry, with varying degrees of elaboration: the cries of the good and bad souls as they awake and arise from their graves, Christ's reproaches to the bad and blessing to the good, the dialogue between Christ and the good and bad souls, the attempts of the bad souls to justify themselves and the final blessing and damnation. And this set of incidents seems to constitute the general framework of the plays. Comparison of this portion of the plays with the treatment of the same theme in *The Pricke of Conscience*[1] makes it seem that even this portion was already more or less prepared for by the dialogue treatment of the same theme in verse. Chester has departed far from the simple scheme of York, the most noticeable difference being that the saved and the damned souls become particular persons representing various classes and kinds of people, each person having put into his mouth a repentant speech revealing the particular vices of his class of society. For this development the play is largely indebted to the various satires on the classes of the times, and perhaps to *The Dance of Death* literature.[2] Coventry has departed from the simple York scheme mainly in the matter of the devils at the end of the play[3] becoming the accusers of the bad

[1] Ll. 6096 ff.; see further *Lamentacio Animarum*, in the same volume as *Be Domes Daege; Minor Poems of V. MS*, Vol. II, pp. 658 ff., 765 ff.; *An Old Eng. Misc.*, pp. 72 ff.; *Anglia*, Vol. III, p. 542. Compare the *Christ of Cynewulf* (ed. Cook), ll. 1470 ff.; here the treatment of the theme is in monologue. Compare also the Latin dialogue treatment of the same in *Hymni Latini* (Mone), Vol. I, pp. 416 ff. See for parallel passages, Appendix, pp. 35 ff.

[2] See CHAMBERS, *The Med. Stage*, Vol. II, p. 153 (notes); Creizenach, Vol. I, p. 461.

[3] The play is incomplete at the end.

souls, recounting their sins and tormenting them. This may be due to the influence of the Towneley *Judgment*, in which this becomes the chief incident of the play, Tutivillus there becoming the dominant figure and taking the center of the stage most of the time. An old fragment of a poem in *Reliquiae Antiquae*[1] shows that this conception of Tutivillus was current in the literature of the day.

It is in the Towneley *Judgment*, however, that we have the farthest departure from the simple structure of York,[2] and it is in this play that we have the best example of how the plays sometimes drew largely on the other forms of literature of the day. Excepting ll. 434–531, which seem to be the germ portion of the play,[3] almost the entire play is made up of portions of verse gathered from various sources, echoing various independent forms and types, and withal blended together in a remarkably effective and dramatic fashion. The writer of this play and presumably of the Towneley *Noah*, *Herod the Great*, and the *Shepherd's Play*, *I* and *II*, was familiar with a very considerable portion of the great body of homiletic and satirical poetry of his times, and it is mainly due to his adaptation of it to his dramatic needs that the Corpus Christi play in England is brought to its highest literary development.

The opening lines of the play[4] may be compared with passages in *The Pricke of Conscience* dealing with the same scene.[5] Lines 143–51, 179–87, 282–86, 296–304, 332–67, 576–88 are alliterative lists of sinners who are to be found in hell, which have been current in Middle English homiletic verse from the *Moral Ode*[6] poems on. Lines 394 ff. are exceedingly similar to the lines in other poems which describe judgment day,[7]

[1] Vol. I, p. 257.

[2] See the York *Judgment Day* text for parallel passages in *York* and *Town*.

[3] See above, p. 96.

[4] *Town.*, pp. 367 ff.; see also *York*, pp. 500 ff.; *Cov.*, p. 402.

[5] Pp. 135 ff., 190 ff., 199; see also *Rich. Rolle of Hamp.*, Vol. II, p. 446.

[6] *Anglia*, Vol. I, pp. 6 ff. (for other editions, see *A Middle English Reader*, ed. O. F. Emerson, p. 297). For other passages of the kind, see *York*, p. 340; *Cov.*, p. 404; *An Old Eng. Misc.*, pp. 64, 67, 76, 150 ff., 187, 212, 225; *Minor Poems of V. MS* (EETS), Vol. I, pp. 253 ff.; *Altenglische Sprachproben*, pp. 330 ff.; *The Poems of Dunbar* (Scot. T. Soc.), pp. 79, 81, 221; *The Poetical Works of Skelton* (Dyce), Vol. I, pp. 98, 149, 369; *Religious Songs* (Percy Soc., Vol. XI) pp. 80 ff.; *Eng. Stud.*, Vol. I, p. 99; *Pricke of Cons.*, pp. 92, 164 ff.; *Rich. Rolle of Hamp.*, Vol. I, p. 153; *Chaucerian and Other Poems* (Skeat), p. 172; *Herrigs Archiv*, Vol. LXXXVI, pp. 387 ff. See also *Piers Plowman* (ed. Skeat) for many passages of the kind. See Appendix, p. 31, for parallel passages.

[7] See *The Pricke of Cons.*, pp. 71, 165; *Rich. Rolle of Hamp.*, Vol. I, p. 129; *Twenty-six Polit. and Other Poems*, pp. 118, 142. For the Latin form see *Hymni Latini* (Mone), Vol. I, pp. 402, 415; see further *Latin Hymns* (March), pp. 154 ff., 292 f. See Appendix for parallels.

probably a rendering of the great "Dies irae," most familiar to us in modern times in Sir Walter Scott and Mozart. This passage is followed immediately by *Christ's Testament.*[1] Almost all of the remaining portions of the Towneley *Judgment* are adaptations of satires on various subjects, mainly on women.[2] While taken collectively, the English judgment-plays seem to be the adaptation of the Doomsday dialogue between Christ and the good and bad souls to dramatic purposes. Towneley is very largely homiletic in its tone, and but for the previous development of the Middle English sermons in prose and verse could never have taken on its present form.

This is scarcely the place to call attention to the relation of the drama to other forms of Middle English poetry whose character is not in some sense lyrical. It is going somewhat out of the way to notice, for example, the similarity between the grotesque meal of the shepherds in the Towneley *Shepherd's Play*, No. I[3] and the *Grotesque Receipts*,[4] between the speech of Death in *The Slaughter of the Innocents*[5] and *The Dance of Death* of Lydgate, between the *Geography in Verse*[6] and the Hegge play of *The Temptation;*[7] between *The Fifteen Signs of Judgment* in the Chester play *Ezechiel* and the treatment of the same theme in non-dramatic verse;[8] and finally between the various *Creeds*, *Pater Nosters*, *Ten Commandments*, and other themes of a somewhat similar nature, treated in the general poetry of the time and the drama as well.

Leaving out of consideration these last-mentioned forms, it is apparent even from the hasty consideration of the lyrical forms given above, and it will be still more apparent after the more careful consideration of that

[1] See above, p. 96.

[2] I hope to publish very shortly a paper on the subject of the influence of the satire of the day upon the Corpus Christi plays.

[3] See also, *Chester*, Vol. I, pp. 119 ff.

[4] *Anglia*, Vol. XVIII, p. 295; Vol. XXVI, p. 270; *Rel. Ant.*, Vol. I, pp. 51, 56, 81, 239, 250, 325; *Bann. MS*, Vol. II, pp. 388, 402 ff.; *Songs and Carols* (Percy Soc., Vol. XXIII), p. 23. See Appendix, p. 34, for parallel passages.

[5] *The Coventry Mysteries*, pp. 84 ff.; cf. *Chester*, Vol. I, p. 186.

[6] *Rel. Ant.*, Vol. I, p. 271; see also *The Play of the Sacrament*, ll. 15 ff.; Manly, *Pre-Shaks. Drama.* Vol. I, p. 243.

[7] Pp. 210 ff.

[8] See *Be Domes Daege and Other Pieces* (EETS), pp. 91 ff.; *Anglia*, Vol. III, pp. 534 ff.; Vol. XI, pp. 369 ff.; Mätzner's *Alteng. Sprachproben*, pp. 121 ff.; *Jahrbuch für romanische und englische Philologie*, Vol. V, pp. 194 ff.; Paul and Braune, Vol. XI, pp. 413 ff.; R. Peiper, "Zur Gesch. der mittelalt. Dichtung," in *Arch. f. Literaturgesch.*, Vol. IX, pp. 117 ff.

large body of non-dramatic and dramatic *Planctus Mariae*, and the still larger body of lyrical dialogue covering almost as completely as the lyrical plays themselves the field of biblical narrative, to what extent the plays are indebted to the antecedent and contemporaneous religious lyric of Middle English. It is hardly going too far when we say that about one-fourth of the great body of material found in the York and Towneley cycles is in the broad sense of the word lyrical. Chester and Hegge, though not indebted to the lyric so largely as are York and Towneley are, when we consider them in their entirety, very considerably indebted. Sometimes, as has been suggested, the dramatic lyric contains merely an echo of the lyric proper; sometimes it follows it in thought and phrase more or less closely; sometimes it has been inserted bodily from without, retaining the phrase and rhyme of the original; and very occasionally the lyric may even have formed perhaps the starting-point of certain of the plays. Of course, it is open to anyone to believe that the original lyric portions of the liturgical drama came by a gradual process of development to their present form in the Corpus Christi plays. But it seems highly probable that in the great majority of cases as the drama widened its scope, it drew again and again upon the vast field of the lyric, which was developing side by side with it using the same themes as the drama and treating these themes in a way not essentially different.

Whatever may be the specific relation of the particular lyrics to particular plays, it is fairly clear that we have here another example of the method of development of the drama as stated by Professor Manly in his explanation of the relation of the moralities to the Corpus Christi plays. "The moralities," he says, "are not to be regarded as growing out of the Corpus Christi plays, but are merely an instance of the theory that the dramatic instinct, once set going, tended to dramatize material already at hand in other provinces of literature."[1] So it is in regard to the lyrics. The drama has done with them what it has been doing ever since it took its rise in the liturgy. It has simply extended its province in such fashion as to include other contemporaneous forms of literature already existing side by side with it.

[1] For the larger application and fuller development of this theory see MANLY, "Literary Forms and the New Theory of the Origin of Species," *Modern Philology*, Vol. IV, pp. 577 ff.

ANNOTATED LIST OF NATURAL HISTORY WORKS, ESPECIALLY USEFUL TO ROCKY MOUNTAIN STUDENTS

I. The Vertebrates

By Junius Henderson

Since nature-study assumed so prominent a place in the public esteem and in school curricula, numerous inquiries are received from parents, teachers, and others as to the most helpful works on the subject. This paper is designed to answer some of the inquiries. The works here given are scientific and reliable, very different from many books now finding their way into private and school libraries under the guise of natural history works. The omission of titles from this list does not signify that the omitted works are necessarily less worthy of notice. The number of good books precludes the mention of all. A list such as this is not needed by the professoinal naturalist, who knows most of them. Consequently this paper, though including some technical works, is directed to the non-technical public, particularly to those who reside in the Rocky Mountain or Pacific Coast region.

From the beginning birds have occupied the most prominent place in nature-study and bird literature has expanded to great proportions, affording large numbers of works suitable to the general student, only a small number of which can be selected for notice here. With mammals the number is far less, with fishes still less, and in case of reptiles and amphibians there are very few works of merit written for popular use.

The classes are herein taken up in regular order, first giving the general works which include all the vertebrates, then beginning with fishes and ending with mammals.

VERTEBRATES IN GENERAL

Schmeil, Otto. *Text Book of Zoölogy.* English Edition, Adam and Charles Black. London. 1901. 486 pages.

Instructive account of appearance, structure and habits of animals in non-technical language. More than one-half devoted to vertebrates.

KINGSLEY, J. S. *Text Book of Vertebrate Zoölogy.* Henry Holt & Co. 1906. 439 pages. $3.

A fine work for the laboratory student of vertebrates, discussing in detail the various organs and structures, such as teeth, tongue, skin, nervous system, etc., with a systematic account of the classification of vertebrates, illustrated by text figures.

JORDAN, DAVID STARR. *A Manual of the Vertebrate Animals of the Northern United States.* A. C. McClurg. 9th Edition. $2.

A small manual, with brief descriptions of the species of the eastern United States, necessarily including some which range westward.

HORNADAY, WILLIAM T. *The American Natural History.* Charles Scribner's Sons. 1904. 438 pages. $3.50.

One of the most useful popular works on the vertebrates, containing a vast amount of highly interesting information in language easily understood even by children and well illustrated. We recommend it to parents and teachers.

The American Bird and Nature-Study Chart, with Manual by Albert Schneider. John C. Mountjoy. $23.

Colored plates of birds, mammals, etc., produced by "color photography," on large sheets arranged on a frame for convenient exhibition to classes and small audiences. The pictures are good, many of them excellent, grouped so as to show relations of birds and other animals to each other. The Manual is a condensed descriptive summary of the subjects treated, with suggestions for use of the chart as well as for field observations. An important addition to schoolroom paraphernalia.

Report upon Geographical and Geological Explorations West of the One Hundredth Meridian in Charge of Capt. Geo. M. Wheeler. Vol. V, *Zoölogy.* ("Wheeler Survey.") Washington. 1875.

Report of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean. ("Pacific R. R. Survey.") Washington.

These two thick quarto volumes contain important papers on western mammals, birds, reptiles, amphibians, and fishes, with excellent plates. The bird papers are superseded by later manuals, but the others are still useful to western naturalists.

HORNADAY, WILLIAM T. *Taxidermy and Zoölogical Collecting.* Charles Scribner's Sons. 1902. 350 pages. $2.50.

One of the most thorough and practical works for general use on the subject of collecting and preserving vertebrates of all kinds, with chapters on the invertebrates. The author has had long experience in that line and has the faculty of making his meaning plain to the non-technical. The work is well illustrated.

FISHES

JORDAN, DAVID STARR. *Guide to the Study of Fishes.* 2 Vols. Henry Holt & Co. 1905. 1223 pages. $12.

An elaborate general treatise, with chapters on life, anatomy, form, morphology, organs, habits, distribution, evolution, diseases, classification and general characters of orders and families, without descriptions of species, all in language not too technical for the general student who is familiar with biological terms.

HERDMAN, W. A., BRIDGE, T. W., AND BOULENGER, G. A. *Cambridge Natural History.* Vol. VII, *Fishes.* The Macmillan Co. $4.25.

A useful general treastise on fishes.

JORDAN, D. S., AND EVERMANN, B. W. *The Fishes of North and Middle America.* 4 Vols. or parts. U. S. Natl. Museum, Bull. No. 47. 1896–1900.

A technical systematic manual, describing all species of North and Middle American fishes known at time of publication, the last volume chiefly excellent uncolored plates. It may be consulted in the large public libraries.

JORDAN, D. S., AND EVERMANN, B. W. *American Food and Game Fishes.* Doubleday, Page & Co. 1902. 574 pages. $4.

One of the most useful popular works on fishes, discussing habits, habitats, etc., with descriptions of species and excellent plates. Includes only those used for food or considered game, comprising about one-third of the 3,000 species in America north of Panama.

GOODE, G. B. *American Fishes.* Revised Edition edited by Theodore Gill. Dana, Estes & Co. 1903. 533 pages. $3.50.

A standard popular work on game and food fishes with special reference to habits and methods of capture. Devotes but little space to descriptions of species, but contains a great fund of information on life-histories not found in other books, with fisheries statistics. A valuable work. Illustrated.

HENSHALL, J. A. *Bass, Pike, Perch and Others.* The Macmillan Co. 400 pages. $2.

An extended and instructive account of nearly all the game fishes east of the Rocky Mountains, with descriptions, notes on habits, and some fishing experiences. Illustrated.

SAGE, DEAN, HARRIS, W. C., AND TOWNSEND, C. H. *Salmon and Trout.* The Macmillan Co. $2.

Similar to Henshall's work above mentioned and belonging to the same set.

JORDAN, D. S. *Report of Explorations in Colorado and Utah during the Summer of 1889, with an Account of the Fishes Found in Each of the River Basins Examined.* Bull. U. S. Fish Com., Vol. IX, for 1889, pp. 1–40.

JUDAY, CHANCEY. *List of Fishes Collected in Boulder County, Colorado, with Description of a New Species of Leuciscus.* Bull. U. S. Bureau Fisheries, 1904, pp. 223–227. 1 fig.

REPTILES AND AMPHIBIANS

GADOW, HANS. *Cambridge Natural History: Amphibians and Reptiles.* The Macmillan Co. 1901. $4.

A general account of these animals for advanced students.

COPE, EDWARD D. *The Crocodilians, Lizards, and Snakes of North America.* Ann. Rept. U. S. Natl. Museum for 1898.

Our most important technical systematic manual, of about 1,200 pages, describing the species, with a number of plates and many text figures.

DITMARS, R. L. *The Reptile Book.* Doubleday, Page & Co. 1907. 465 pages. $4.

Discusses the snakes, lizards, crocodiles, tortoises, and turtles in non-technical language, with 136 very fine full-page plates from photographs, some of them colored. For the general student far the most useful book yet published on American reptiles, practically the only popular book on the subject, elaborately gotten up, also indispensable to the technical herpetologist. The reptiles form a very interesting group, the study of which during youth would do much to dispel the horror most people have of snakes, the majority of which are not only harmless, but quite useful. This book should have a wide circulation.

STEJNEGER, LEONHARD. *The Poisonous Snakes of North America.* Ann. Rept. U. S. Natl. Museum for 1893, pp. 337–487.

Describes the poisonous species, with illustrations and a lengthy discussion of the effects of the poison and methods of treatment.

DICKERSON, MARY C. *The Frog Book.* Doubleday, Page & Co. 1907. 240 pages. $4.

Describes the species of toads and frogs, illustrated by over 300 photographs from life with minute discussion of life-histories and an extensive bibliography. The most useful popular book treating these interesting animals, indispensable to one who wishes to study them in detail.

HERRICK, C. L., TERRY, JOHN, AND HERRICK, H. N. *Notes on a Collection of Lizards from New Mexico.* Bull. Univ. N. Mex., Vol. I, 1898, pp. 117–148 and plates.

BIRDS

NEWTON, ALFRED, AND GADOW, HANS. *A Dictionary of Birds.* Adam & Charles Black, London. 1893–1896. 1058 pages.

As the title indicates, the subjects such as "Feathers," "Flight," "Finches," "Swallows," etc., are arranged alphabetically, not systematically. Contains general information, not descriptions of species. Authoritative and very useful.

EVANS, A. H. *The Cambridge Natural History.* Vol. IX, *Birds.* The Macmillan Co. 1899.

A general treatise on structure and habits of the various groups, more particularly for advanced students. Does not describe species.

BEEBE, C. WILLIAM. *The Bird: Its Form and Function.* Henry Holt & Co. 1906. 496 pages. $3.50.

One of the most important recent books for general students of birds, containing much not found elsewhere in so accessible a form, concerning structure and adaptation thereof to habits. Not a descriptive work on anatomy, but rather on the relation of parts, with inquiry as to reasons therefor, taking up in order the feet, wings, bills, etc. Very useful for anyone fond of nature, and helpful in understanding like features in other groups, such as mammals, reptiles, etc.

KEYSER, LEANDER S. *Birds of the Rockies.* A. C. McClurg & Co. 1902. 345 pages. $1.50.

The title seems a misnomer. It does not describe birds or their habits to any great extent, but tells of the author's interesting experiences in Colorado in search of birds. Its chief ornithological value is a briefly annotated list of Colorado birds in the back of the book.

HERRICK, FRANCIS HOBART. *The Home Life of Wild Birds.* G. P. Putnam's Sons. 1901. 243 pages. $2.

A fine exposition of modern methods and results of hunting birds with camera instead of with shotgun, studying them at short range. Contains much information, as a result of such close study, as to nesting habits, food of nestlings, etc., not found in other books.

FINLEY, WILLIAM LOVELL. *American Birds.* Charles Scribner's Sons. 1907. 250 pages. $1.50.

An account of field observations of many species at short range, with a vast amount of information on habits, superbly illustrated by numerous photographs clearly showing the possibilities in the use of the camera for the study of wild creatures.

WEED, CLARENCE M., AND DEARBORN, NED. *Birds in Their Relation to Man.* J. B. Lippincott & Co. 1903. 373 pages. $2.50.

Treats of the food habits of birds and their usefulness, a most important phase of bird study. A summary of our knowledge of the subject, bringing into one volume of convenient size and low price the information which was scattered through innumerable

bulletins, etc. Contains an extensive bibliography of economic ornithology, and as everyone interested in the subject should have this book we omit from this catalogue all those papers.

FORBUSH, EDWARD HOWE. *Useful Birds and Their Protection.* Massachusetts State Board of Agriculture 2d ed., 1907. 422 pages. $1.

A very elaborate work, treating economic ornithology first in a general way, then in detail with reference to Massachusetts species. The most useful American work on the subject. Well illustrated.

RIDGWAY, ROBERT. *Birds of North and Middle America.* U. S. Natl. Museum, Bull. No. 50, Parts I to IV. 1901–1907. Other parts to follow.

The greatest technical systematic work on American ornithology, intended to describe all the species in eight good-sized volumes. Descriptions are full and minute, an exhaustive bibliography accompanying each description. Contains nothing concerning habits. Available in larger public libraries.

RIDGWAY, ROBERT. *A Manual of North American Birds.* J. B. Lippincott & Co. 4th edition. 1900. 614 pages. $7.50.

A descriptive manual in one thick volume arranged in form of a key. Descriptions brief and technical. Figures of bills, feet, and wing and tail feathers in back of book. Very convenient for identification of birds in the hand for minute examination, not so useful for beginners or for field use.

COUES, ELLIOTT. *Key to North American Birds.* Dana Estes & Co. 5th edition, 1903. 2 Vols. (Former editions one volume.) 1152 pages. $12.50.

Descriptions more extended and somewhat less technical than in Ridgway's *Manual*, with considerable information on habits and many useful illustrations, consequently better for the general non-technical student who deals with birds chiefly in the field. A valuable introduction deals with structure, classification, the collecting and preserving of birds, nests, eggs, and other useful information, unfortunately not revised in the last edition.

CHAPMAN, FRANK M., AND REED, CHESTER A. *Color Key to North American Birds.* Doubleday, Page & Co. 1903. 289 pages. $2.50.

The most useful book for amateur identification of birds in the field. Descriptions meager but aided by about 800 colored figures, which, though small and not works of art, enable one readily to recognize many species.

CHAPMAN, FRANK M. *Handbook of Birds of Eastern North America.* D. Appleton & Co. 6th edition, 1903. 414 pages. $3.

BAILEY, FLORENCE MERRIAM. *Handbook of Birds of the Western United States.* Houghton, Mifflin & Co. 1902. 485 pages. $3.50.

General plan of these two handbooks the same, one covering eastern species, the other confined to the Rocky Mountain and Pacific Coast Regions and therefore more useful to western students. The descriptions are brief and non-technical, illustrations helpful and prices bring them within reach of many who would not feel justified in purchasing the great works of Ridgway and Coues.

BAIRD, S. F., CASSIN, JOHN, AND LAWRENCE, G. N. *A Monograph of the Birds of North America North of Mexico.* Pac. R. R. Survey Repts. Vol. IX. Washington. 1858.

Describes all birds known for the United States and Canada at that time, once most mportant but now supplanted by later and more complete manuals.

KNIGHT, WILBUR C. *The Birds of Wyoming.* Wyo. Exper. Sta., Univ. of Wyo., Agric. Dept., Bull. No. 55. 1902.

COOKE, W. W. *Birds of Colorado.* Agric. Exper. Sta. of Agric. College of Colo., Bulls. No. 37 (1897), 44 (1898) and 56 (1900).

These four pamphlets are most necessary for Rocky Mountain ornithologists, being complete catalogues of the known species of the two states up to time of publication, with valuable notes on distribution, abundance, migration, habits, etc. A few species since found in Colorado are recorded in *The Auk.*

COUES, ELLIOTT. *Birds of the Northwest.* U. S. Geol. & Geog. Sur. Terr. (Hayden Survey), Miscel. Pub. No. 3. 1874.

A very valuable treatise on habits of a large number of Rocky Mountain and Pacific Coast species.

COUES, ELLIOTT. *Birds of the Colorado Valley.* U. S. Geol. & Geog. Sur. Terr. (Hayden Survey), Miscel. Pub. No. 11. 1878.

"A repository of scientific and popular information concerning North American ornithology," particularly useful to western students.

BENDIRE, CHARLES. *Life Histories of North American Birds with Special Reference to Their Breeding Habits and Eggs.* U. S. Natl. Museum. Part 1, Spl. Bull. No. 1, 1892; Part 2, Spl. Bull. No. 3, 1895.

Exhaustive accounts of habits, with magnificent colored plates of the eggs. Death of the author prevented completion of the work which was intended to cover all North American species in five quarto volumes.

REED, CHESTER A. *North American Birds' Eggs.* Doubleday, Page & Co. 1904. 365 pages. $2.50.

Very briefly describes the birds, nests, eggs and habits. Eggs figured in black and white, showing distribution of colors as well as possible without the actual colors and showing the shape accurately.

MERRIAM, FLORENCE A. *Birds of Village and Field.* Houghton, Mifflin & Co. 1898. 400 pages. $2.

Brief descriptions and copious comments on the habits of over 150 common species of birds, with a key thereto by colors for use in the field. An excellent book for beginners.

MILLER, OLIVE THORNE. *The First Book of Birds.* Houghton, Mifflin & Co. 1899. 144 pages. 60 cts.

The best general bird book for children, telling of the living bird, its structure, growth and habits, not describing species. Language simple and clear.

MILLER, OLIVE THORNE. *The Second Book of Birds.* Houghton, Mifflin & Co. 1901. 204 pages. $1.10

Supplements "The First Book of Birds," treating them in a general but systematic way by families, with accounts of the principal species under each family.

ECKSTROM, FANNIE H. *The Woodpeckers.* Houghton, Mifflin & Co. 127 pages. $1.

A fine popular account of these birds which are so useful to mankind in the preservation of trees from the ravages of insects.

CHAPMAN, FRANK M. *The Warblers of North America.* D. Appleton & Co. 1907. 300 pages. $3.

An elaborate, authentic, up-to-date monograph of the wood warblers, with excellent colored plates.

FISHER, A. K. *The Hawks and Owls of the United States in Their Relation to Agriculture.* U. S. Dept. Agric., Div. Orn. & Mam., Bull. No. 3. 1893.

A very important monograph, containing detailed account of the habits of the various species, illustrated by colored plates.

RIDGWAY, ROBERT. *The Humming Birds.* U. S. Natl. Mus., Ann. Rept. for 1890, pp. 253–383.

The standard work on the hummers, well illustrated.

BENDIRE, CHARLES. *The Cowbirds.* U. S. Natl. Mus., Ann. Rept. for 1893, pp. 587–624. With plates.

ELLIOTT, DANIEL G. *North American Shore Birds.* Francis P. Harper. 1895. 253 pages.

An authoritative non-technical monograph of North American snipes, sandpipers, plovers, and their allies. Illustrated.

SANDYS, EDWYN, AND VANDYKE, G. S. *Upland Game Birds.* The Macmillan Co. 1902. 414 pages. $2.

Describes the partridges, quail, grouse, ptarmigan, turkeys, woodcock, plover, cranes and mourning dove, with extended notes on habits.

GRINNELL, GEORGE B. *American Duck Shooting.* Forest & Stream Pub. Co. 1901. 616 pages. $3.50.

This work, instead of being a collection of hunting stories as one might infer, is an extended illustrated monograph of the American ducks, geese and swans, with full accounts of their habits and the methods of hunting them, in interesting, non-technical language.

SANFORD, L. C., BISHOP, L. B., AND VAN DYKE, T. S. *The Water Fowl Family.* The Macmillan Co. 1903. 579 pages. $2.

A full descriptive discussion of the ducks, geese, swans, waders and shore birds, and their habits, with a fine account of hunting methods.

The Auk. Vols. I–XXIV. 1884–1907. The American Ornithologists' Union. $3 per year.

A thick quarterly, the leading American ornithological magazine.

The Condor. Cooper Ornithological Club. Vols. I–IX. 1899–1907. $1.50 per year.

An excellent bi-monthly magazine devoted to western ornithology.

Bird-Lore. The Macmillan Co. Vol. I–IX. 1899–1907. $1 per year.

The leading popular bird magazine of America, "published for the Audubon Societies." Bi-monthly.

Birds and Nature. (At first called simply "Birds.") Vol. I–XIX. 1896–1907. A. W. Mumford.

A popular magazine, illustrated by "color photography." Suspended in June, 1907.

MAMMALS

BEDDARD, FRANK E. *The Cambridge Natural History: Mammalia.* The Macmillan Co. 1902. $4.

A general treatise on mammals, discussing their characteristics and traits in a systematic way.

INGERSOLL, ERNEST. *The Life of Animals: The Mammals.* The Macmillan Co. 2d edition, 1907. 526 pages. $2.

A highly interesting and instructive work, treating accurately but in popular language the habits of mammals in a wild state, with more or less discussion of structure and relationships and extensive bibliography.

STONE, WITMER, AND CRAM, WM. E. *American Animals.* Doubleday, Page & Co. 1902. 318 pages. $3.

Deals with mammals, not animals in general. A general account in popular language of the various families and some of the principal species, with brief descriptions and notes on habits. Many full-page illustrations. Though chiefly eastern, very useful in the West in the absence of recent elaborate manuals such as we have of the birds.

BAIRD, SPENCER F. *Monograph of the Mammals.* Pac. R. R. Survey Repts. Vol. VIII. 1857.

Includes all mammals known in the United States to time of publication and many plates. Though old, it is still almost indispensable to students of mammals, but must be used with caution, as many more species are now known and nomenclature is ancient.

ELLIOTT, D. G. *Synopsis of the Mammals of North America and the Adjacent Seas.* Field-Columbian Museum, Zoöl. Ser., Vol. II. 1901. Also supplement, Vol. II, No. 2.

Very briefly describes the species, with numerous figures, mostly of skulls. Very important, bringing together the described species.

WARREN, EDWARD R. *The Mammals of Colorado.* Colorado College Public., Vol. IX, pp. 225–274. 1906.

Gives known range of all species recorded for the state up to time of publication, with bibliography. A great aid to students of Colorado mammalogy and should stimulate an interest in the subject.

COUES, ELLIOTT, AND ALLEN, J. A. *Monograph of North American Rodentia.* U. S. Geol. & Geog. Sur. Terr. (Hayden Survey), Mon. Vol. XI. 1877.

An elaborate descriptive manual of rodents in a thick quarto volume, indispensable to mammalogists, the order including a large proportion of our mammals.

COUES, ELLIOTT. *Fur-Bearing Animals: A monograph of North American Mustelidæ.* U. S. Geol. & Geog. Sur. Terr. (Hayden Survey), Miscel. Pub. No. 8. 1877.

Gives descriptions and copious notes on habits of wolverines, martens, ermines, minks, weasels, skunks, badgers and otters.

ALLEN, HARRISON. *A Monograph of the Bats of North America.* U. S. Natl. Mus., Bull. No. 43. 1893.

ROOSEVELT, THEO., VANDYKE, T. S., ELLIOTT, D. G., AND STONE, A. J. *The Deer Family.* The Macmillan Co. 1903. 325 pages. $2.

A general account, in popular style, of the species of deer, etc., including the prong-horn antelope, which does not belong to that family.

WHITNEY, CASPER, GRINNELL, GEO. B., AND WISTER, OWEN. *Muskox, Bison, Sheep and Goat.* The Macmillan Co. 1904. 274 pages. $2.

Of same nature as *The Deer Family.*

BURROUGHS, JOHN. *Squirrels and Other Fur-Bearers.* Houghton, Mifflin & Co. 144 pages. 60 cts.

A very entertaining account of squirrels, woodchucks, rabbits, skunks, foxes, weasels, minks, raccoons, porcupines, opossums, mice, etc., in popular language. Interesting to all, especially valuable for children.

WRIGHT, MABEL OSGOOD. *Four-footed Americans and Their Kin.* The Macmillan Co. 432 pages. $1.50.

Natural-history facts told in fine story form for young folks. Well illustrated.

LYON, MARCUS WARD. *Classification of the Hares and Their Allies.* Smithsonian Misc. Collec., Vol. XLV, pp. 321–447. 1904.

TRUE, F. W. *A Revision of the American Moles.* Proc. U. S. Natl. Mus., Vol. XIX, pp. 1–111. 1897.

BAILEY, VERNON. *The Pocket Gophers of the United States.* U. S. Dept. Agric., Div. Orn. & Mam., Bull. No. 5. 1895.

BAILEY, VERNON. *The Prairie Ground Squirrels or Spermophiles of the Mississippi Valley.* U. S. Dept. Agric., Div. Orn. & Mam., Bull. No. 4. 1893.

PALMER, T. S. *The Jack Rabbits of the United States.* U. S. Dept. Agric., Div. Biol. Sur., Bull. No. 8. 1897.

MERRIAM, C. HART. "The Prairie Dog of the Great Plains." U. S. Dept. Agric., *Year Book for 1901*, pp. 257–270.

North American Fauna. U. S. Dept Agric., Div. Biol. Sur. 1889–1907.

The following numbers of this excellent series are particularly useful, authors names and dates being omitted and titles abbreviated:

1. Revision of North American Pocket Mice.
8. Revision of Pocket Gophers.
10. Revision of Shrews of Genera Sorex, Notiosorex and Blarina.
11. Synopsis of Weasels.
12. Genera and Subgenera of Voles and Lemmings.
13. Revision of Bats of Family Vespertilionidæ.
15. Revision of Jumping Mice of Genus Zapus.
17. Revision of Voles of Genus Microtus.
18. Revision of Pocket Mice of Genus Perognathus.
20. Revision of Skunks of Genus Chincha.
26. Revision of Skunks of Genus Spilogale.

ECOLOGICAL NOTES FROM NORTH-CENTRAL COLORADO

By Francis Ramaley and W. W. Robbins

The following three studies were made by the writers in June 1907 while on a collecting trip in northern Larimer County, Colorado. All the work was recorded in the field notebooks. The office work has consisted in putting the material into form for publication.

Vegetation Studies at Red Mountain.—Red Mountain[1] is in Larimer County, Colo., about 26 miles by road northwest of Ft. Collins. It is a butte formed by the erosion of wide valleys all around it. The material of the mountain is sedimentary rock, chiefly rather fine-grained sandstone. The strata are nearly horizontal and the harder and softer layers, weathering at different rates, mark off a series of ledges at different heights. The top of the mountain has an altitude of 7,095 feet and extends about 600 feet above the surrounding country. Cercocarpus bushes (*Cercocarpus parvifolius*) are distributed about evenly all over the top and sides of the mountain but these thin out and stop rather abruptly at the base where the inclination of slope is more gradual and where there is an accumulation of soil.[2] On the north side of the mountain only there are some scattered pines (*Pinus scopulorum*) and cedars (*Sabina scopulorum*) but these are all very far apart.

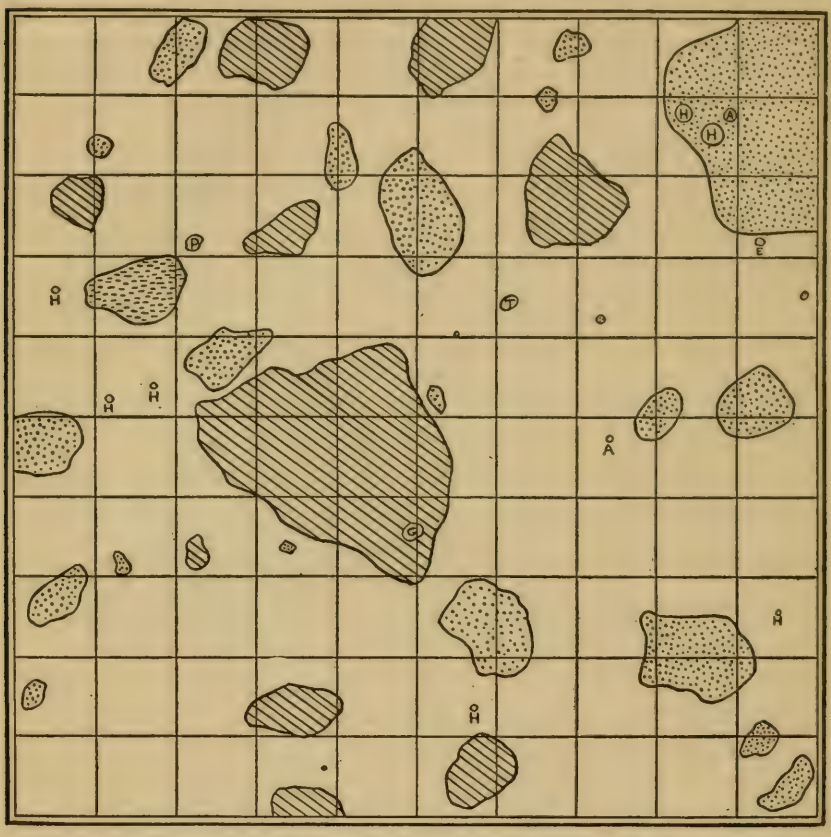
A typical place on the south side of the mountain was selected for study and an area two meters square sloping gently to the south was staked off and mapped. The map, which is here reproduced, shows the location of Cercocarpus bushes and indicates their distance apart. In addition to these shrubs there are various herbaceous plants as indicated.

Immediately at the south base of Red Mountain is a considerable area, about 500 meters wide sloping down to Ten Mile Creek, the soil of which is a fine-grained sand. Here there is a valley grassland for-

[1] For a map of this region see an article entitled "Botany of Northeastern Larimer County, Colo.," by Ramaley in these *Studies*, Vol. V, pp. 119–131.

[2] See in this connection the account of the Cercocarpus Scrub Formation in the article named above.

mation but with bunches of shrub-like plants chiefly *Glycyrrhiza lepidota*, *Chrysothamnus graveolens* and *Eurotia lanata*.



DETAILED VEGETATION MAP OF TWO SQUARE METERS ON RED MOUNTAIN.

In making the map tapes were used to divide the area into 2-dm. squares. These are indicated on the map. All of the plants are shown on the map. Diagonal lines indicate Cercocarpus, dotted areas are grass patches, broken horizontal lines represent *Euphorbia robusta*. The following are designated by their initial letter: Allium, Gaura, Harbouria, Pentstemon, Tetraneuris.

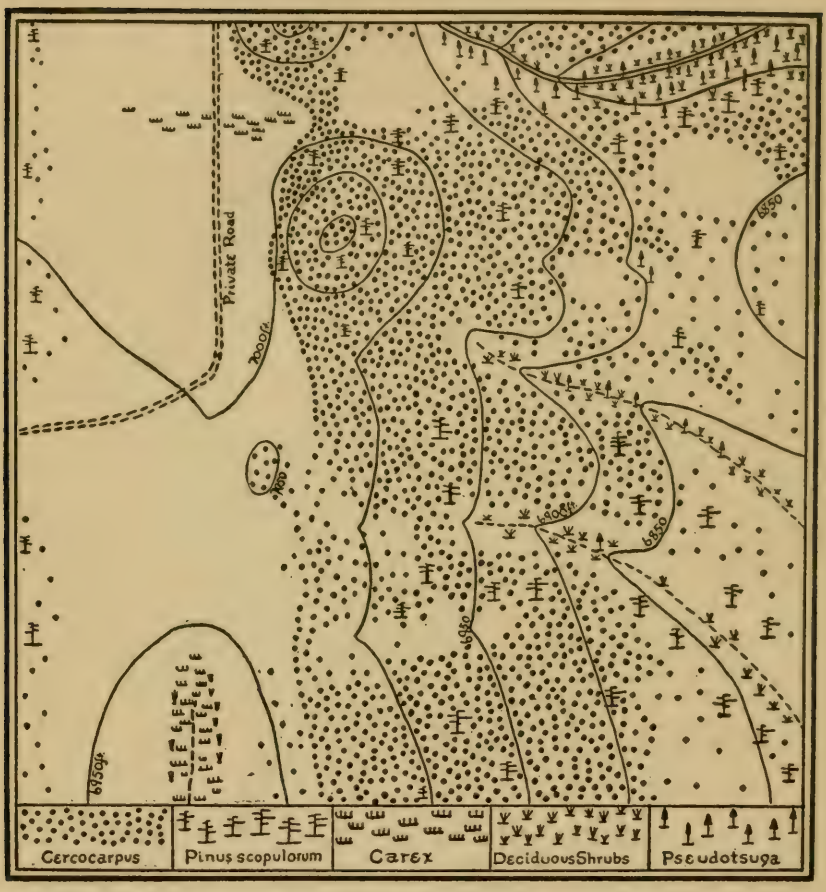
South and west of Red Mountain are rolling plains formed of disintegrated sedimentary rock. The altitude of these plains is about 6,400 feet. They represent a very broad lateral valley extending to the foot-

hills a few kilometers to the west. These plains have a dry grassland vegetation with Cercocarpus on any sharp knoll-tops and with soapweed (*Yucca glauca*) on the south exposures of rounded eminences. Low grasses and low species of Artemisia form probably four-fifths of the soil cover. Other plants which are somewhat abundant are *Aragallus multiflorus*, *Aragallus lamberti*, *Leucocrinum montanum*, *Tetraneuris acaulis*, *Oreocarya virgata*, *Arenaria hookeri*, *Euphorbia robusta*, *Opuntia missouriensis*, *Cactus missouriensis*, *Harbouria trachypleura*, *Homalobus caespitosus*, *Senecio douglassii*, *Eriogonum alatum*, *Chrysothamnus plattensis*, *Astragalus drummondii*, *Pulsatilla hirsutissima*. In shallow draws *Symphoricarpos occidentalis*, *Rhus trilobata* and *Prunus melanocarpa* occur. The soil of these plains is very coarse, derived from the conglomerates of the sedimentary series, but it is so slightly disintegrated that it is often difficult to distinguish it from decomposed granite. This area is interesting from the fact that the plants other than grasses and species of Artemisia are so abundant both in species and in individuals. It differs in this respect from the usual valleys of the sedimentary region. Probably this is because here it is conglomerate which has made the soil, while in other valleys it is a fine-grained sandstone and much better calculated to support grass and sagebrush but not so suitable for other plants.

A Square Mile of Rock Ridge and Foothills.—A study was made of a square mile (Section 35; T. 12, N.; R. 70, W.), and a vegetation map made, which is here reproduced. On this map are shown the various formations. The relative frequency of the various kinds of plants is also indicated, where a close formation occurs the conventional signs used are put close together. The signs used do not, however, represent individual plants. The plant formations[1] of this square mile are those found generally in the northern part of Larimer County, Colorado, along the contact of the granites and the sedimentary deposits, viz.: Cercocarpus Scrub Formation, Valley Grassland, Upland Dry Grass Formation, Canyon Forest Formation, Foothill Forest Formation.

Plants of a U-shaped Gulch.—The gulch studied is about 400 feet wide as measured along the ground surface. North Box Elder Creek,

[1] These formations are somewhat fully discussed in the article previously cited.



VEGETATION MAP OF A SQUARE MILE IN NORTHEASTERN LARIMER COUNTY, COLORADO

Contour intervals 50 ft. Unmarked areas are grassland. At the western edge of the section are low granite hills with a sparse covering of pine and some scattered Cercocarpus and some other bushes, with grasses and various flowering herbs (Foothill Forest Formation). To the east of this is a lateral valley with fine-grained soil supporting a grassland formation. Farther east is a series of sedimentary ridges. At the northeast of the section is a steep gulch with flowing water. Attention is called to the patches of Upland Dry Grass Formation scattered through the sedimentary area and especially to the sharply marked western boundary of the Cercocarpus Formation. The rock ridges of the eastern part of the section contain lime salts and here even the Cercocarpus bushes are widely separated and there are very few grasses and other herbs.

which runs through the gulch, is 6,923 feet above sea level at the place studied. The hills at the side are about sixty feet higher. A west and east line from the top of one hill down through the gulch and up the other side was laid off with stakes every twenty feet. Every plant along this line was recorded and its exact position noted in feet and inches from the preceding stake. This record shows very well the relative abundance of the plants which occur here; while the number of plants found in any of the twenty-foot distances shows the relative closeness or openness of the formation. A few sample records only are given below.

Between Stake 1 and Stake 2 the ground slopes gently to the east. Here 52 plants were touched by the tape-line stretched between the stakes. As most of the plants were not in flower they could not be identified fully but the list will serve the purpose intended, viz., to show the general character of the vegetation with reference to slope, altitude (which here means moisture), character of soil, etc.

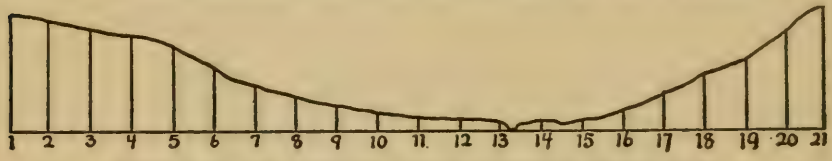
Distance from Stake 1		Name of Plant
Ft.	In.	
0	2	Sage
	6	Green sage
	9	Sage
	11	Selaginella
1	1	Grass
	10	Sage
2	0	Grass patch
	4	
	11	Sage
3	2	Sage
	5	Sage
	11	Sage
4	6	Grass
	8	Sage
	10	Green Sage
4	11	Selaginella
5	8	
5	10	Sage
6	9	Grass
	10	Composite
7	0	Grass patch
	5	
	11	Aragallus
8	5	Antennaria
	10	
9	2	Grass patch
10	3	

Distance from Stake 1		Name of Plant
Ft.	In.	
10	4	Aragallus
	5	Grass patch
	7	
11	1	Aragallus
	7	Grass
	10	Antennaria
12	2	
	4	Eriogonum
13	0	Aragallus
	5	Aragallus
	10	Aragallus
14	7	Sage
15	1	Grass patch
	5	
	10	Sage
16	0	Aragallus
	3	Grass
	8	Grass
17	4	Collinsia
18	0	Aragallus
	4	Composite
	8	Aragallus
19	0	Collinsia
	3	Aragallus
	6	

Between Stake 5 and Stake 6 the ground slopes more abruptly and here only 18 entries were made. These entries are all for single plants, none representing patches or mats. Here is then a very sparse vegetation due to the steepness of slope and insecure footing. Following is the list:

Distance from Stake 5		Name of Plant	Distance from Stake 5		Name of Plant
Ft.	In.		Ft.	In.	
0	5	Grass	13	5	Sage
1	8	Harbouria	14	1	Grass
4	0	Potentilla		7	Sedum
5	0	Pinus scopulorum	16	3	Potentilla
	11			6	Potentilla
8	0	Collinsia		11	Lithospermum
9	5	Eriogonum	17	4	Lithospermum
10	1	Sage		8	Grass
11	4	Grass	19	11	Grass
12	3	Sedum			

Between Stake 9 and Stake 10 the tape passed across a sedge-grass society, a close formation with nothing but sedges and grasses. The



PROFILE OF THE U-SHAPED GULCH DESCRIBED IN THE TEXT

The vertical lines represent imaginary lines drawn from the stakes down to the level of the creek-bed where the numbers of the stakes are indicated. Distance between vertical lines is 20 feet. The same scale is used for both horizontal and vertical distances. Stake 1 is near the top of the slope at the west side of the gulch and Stake 21 is at the same altitude on the east. Box Elder Creek flows between Stakes 13 and 14.

soil here was quite moist. Stakes 12 and 13 are both down in the floor of the gulch on level ground with good soil, quite moist. The formation is close with practically no bare ground. Large patches of grass occur as well as clumps of Senecio, Achillaea and Salix. The entries were made in the following order, distances being omitted here for sake of brevity:

Grass and Achillaea patch, Plantain, Composite, Achillaea, Grass patch, Mimulus, Meadow grass, Achillaea, Mimulus, Senecio, Cow parsnip, Salix, Mertensia, Mertensia, Salix.

In the next twenty feet the following entries were made; distances again omitted here although recorded in the field notes:

Mertensia patch, Salix clump, North Box Elder Creek, Grass patch, Dodecatheon patch, Grass patch, Grass and plantain, Grass patch, Cow parsnip, Grass patch, Cow parsnip, Grass patch.

Between Stakes 14 and 15 the conditions are similar. Here the following records were made:

Grass patch, Carex patch, Grass patch, Collinsia, Mentha, Collinsia, Sedge and grass patch, Grass patch, Carex.

Stakes 19 and 20 are high up the east side of the gulch. A list of the entries shows plants similar to those at the top of the gulch on the other side.

Lichens on rock, Opuntia, *Pentstemon humilis*, Lichens on rock, *Pentstemon humilis*, Grass, Geranim, Grass, Sage, Senecio, Grass, Lichens on rock, Senecio, Senecio, Sage, Draba, Sage, Sage, Grass.

This gulch study is published to give an idea of the differences in the plants along the slopes and in the bottom of such a depression. Of course everyone knows that such differences are manifest, but an accurate statement of conditions in a definite place may be worth while.[1] An examination of the list of plants printed above will give a fair idea of the species represented and of the character of the plants in the drier sloping parts and the moister gulch floor.

[1] No originality is claimed by the writers in the method of this study. Such "transects" are fully discussed by Professor Frederic E. Clements in his important work *Research Methods in Ecology*, pp. 176–181, 1905.

BOTANY OF NORTHEASTERN LARIMER COUNTY, COLORADO

By Francis Ramaley

Introduction.—In June, 1907, a party of four naturalists[1] spent two weeks in north-central Colorado in the interest of the University of Colorado Museum. Although the expedition was planned for the purpose of making collections, a considerable number of interesting facts[2] were gathered which seem worth while publishing at the present time. The author's long acquaintance with the plants of Boulder County has made it possible to classify the formations even with a short study of field conditions in the district under consideration.

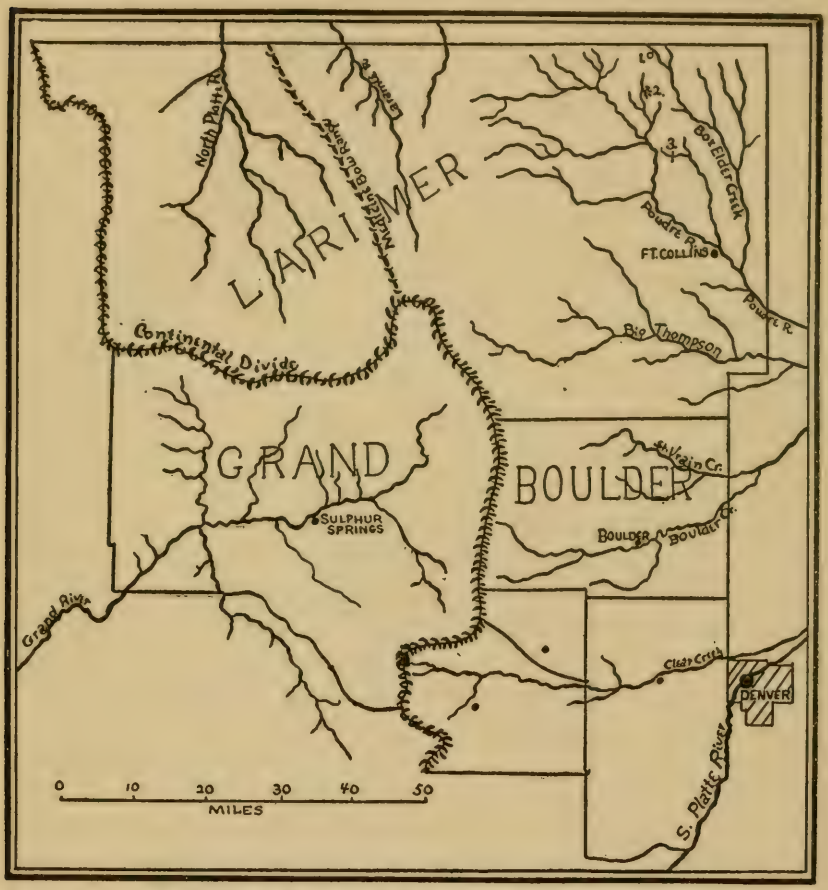
The Area Visited.—The area visited embraces a portion of Larimer County extending from Ft. Collins north to the Wyoming line. A considerable distance the wagon road extends along the "Glade" which is a lateral valley between sedimentary ridges extending in a north and south direction a short distance east of the granite foothills. From Owl Canyon part of the way was along Ten Mile Creek, still in the sedimentaries, while the most northern part of the journey was in the foothill country. The most distant camp was made on North Box Elder Creek 35 miles north of Ft. Collins. From this point trips were made north into Wyoming and east to the high plains and the sedimentary rock ridges. About 150 square miles were examined in somewhat cursory fashion and a number of smaller areas carefully studied and mapped. The trip was made from Ft. Collins by camp wagon; saddle horses were used in making all extensive side trips, in order to save time.

Altitudes.—At Bellevue, a short distance west of Ft. Collins the altitude is 5,125 ft. From here, passing northward up the main highway or "Glade Road," there is a steady and gradual ascent to Owl Canyon where the altitude is about 5,900 ft. The ridges at this point are of

[1] Judge Junius Henderson, Mr. G. S. Dodds, Mr. W. W. Robbins and the writer.

[2] Other articles by different members of the party are planned which will deal with geology and paleontology.

various heights up to 200 ft. above the bed of Owl Creek. Farther north there is a continued rise in the general level as is shown by the



OUTLINE MAP OF NORTH-CENTRAL COLORADO

Only a few of the streams are shown. Larimer County, at the top of the map, is entirely east of the continental divide. Ft. Collins, the county seat, is on the plains a few miles east of the sedimentary rock ridges. The area described in this paper extends north from Ft. Collins to the Wyoming line. Reference figures: 1. Box Elder; 2. Red Mountain; 3. Owl Canyon.

course of streams which is essentially toward the south. At the point where the North Box Elder cuts through its granite canyon into the

sedimentaries the altitude is about 6,900 ft. The highest sedimentary ridges and buttes are 7,200 ft.

The Rock Ridges.—These are the upturned edges of harder layers of a sedimentary series lying above the granites of the Rocky Mountains. The strata dip to the east at some points as much as 20 or 25 degrees (Owl Canyon) and at others (Red Mountain) they are almost horizontal. For some distance south of the Wyoming line the strata form a long series of many ridges extending north and south and parallel with the foothills. These ridges show the following formations named in order from above downward:

Niobrara	Chugwater
Benton	Lyons
Dakota	Fountain
Morrison	

The lowest member of the series, the Fountain, is a coarse, red conglomerate, in many cases rather difficult to distinguish from the underlying granites. Red sandstone is, however, the prevailing material of the ridges and this in weathering produces a fine-grained, compact soil. Alternating layers of harder and softer material become eroded at different rates and this leads to the formation of the series of ridges all sloping to the east, while on the west there may be rather abrupt escarpments. (See Figs. 1, 3, 4.)

The width of the entire sedimentary formation from Fountain to Niobrara varies from three to ten miles. Deep canyons are cut through the ridges at various points. Generally these take a zigzag course first south between two ridges, then east through a ridge, then south again. Isolated portions of the ridges are cut off by stream erosion and in places where the strata are nearly horizontal steep-walled buttes and hills are formed. Some of these have escaped much of the general erosion and now tower far above the general level of the surrounding ridges. Red Mountain is a good example of this condition. Very little soil is to be found on the rock ridges, but here and there a part of the ridge has been so eroded as to deposit washings as a small alluvial fan. In such places there is grassland, while most of the ridge is covered with scrub.

The Granite Foothills.—These are well rounded hills furnishing an example of old topography. Gulches cut by stream erosion are deep but mostly broad with rather gently sloping sides, in marked contrast to the abrupt walls of the gorges in the sedimentary rocks. Disintegration of the exposed granite extends for a few inches or a few feet in depth and cracks as well as soft streaks in the rock permit the roots of shrubs and trees to penetrate as far as need be for moisture. On level ground, especially in lower places where an accumulation of soil has occurred, there is a well-developed plant covering, but on steep slopes and on the tops of hills only trees and shrubs with roots far down in rock crevices can exist with any degree of security. The weathering of the rock is continually loosening the foothold of herbaceous plants. (See Figs. 6, 8, 9.)

Soil.—A large part of the rock ridges is entirely without soil. Where soil accumulates it is rather fine grained, bakes hard, and dries quickly. It is very difficult for shrubs and trees to gain a foothold here and so these places are generally covered with grass and herbaceous plants. Such grassy patches do not occur on the granite hills for when soil accumulates there it leads to development of shrub growth. The soil of canyons shows an accumulation of humus due to the decaying leaves of deciduous trees and shrubs which grow along the stream-banks. Moist meadows, with abundant humus, and even swamps, are found in the valleys of the granite hills. Such meadows do not occur so frequently in the region of sedimentaries, but occasional meadows are found: mention may be made of a broad meadow east of Owl Canyon where a thin layer of humus was seen to overlie the sandstone bed rock. Layers of gypsum and other calcareous material occur at different points in the sedimentary series and when these weather out they form a soil which will support very little vegetation of any kind.

Climatic Conditions.—All of the region studied is arid. At Ft. Collins the average annual rainfall is 14.4 inches. No other records from stations near at hand are known to the writer. However, it can scarcely be doubted that the precipitation is greater at higher altitudes than at lower and that all of the district studied has a greater rainfall than that recorded for Ft. Collins. The difference is probably not more

than three or four inches per annum. Winters are cold and summers hot. There is a great daily range of temperature. At Ft. Collins the average annual temperature is 46.7 degrees Fahrenheit. Extremely low temperatures, as low as −20 degrees occur a few times each winter. There is a great deal of wind and this comes chiefly from the west and northwest as is seen by the bent and twisted tops of the pine trees on the ridges and foothills.

Floras of the Granite and Sedimentary Areas.—Since these two areas are in contact and extend for long distances at about the same altitude it is natural that they should have about the same species of plants. The pines (*Pinus scopulorum*) and cedars (*Sabina scopulorum*) are the only trees except in the gulches and on steep north slopes. Owing to the extremes of temperature and the slight rainfall together with the scarcity of soil, the formations are open. No close growth of pine was seen and the cedars are everywhere widely scattered, for the most part placed on exposed rocks at the tops of abrupt slopes. The most striking difference in the vegetation of the two areas is seen in the presence of a dense scrub of Cercocarpus over most of the sandstone and its almost entire absence on the granite. Lichens, though everywhere present on the granites are not at all common on the sandstone, and Selaginella also seems confined to the granite area. It is quite likely that Selaginella gets over on to the sedimentary rocks in places in this district, for it is abundant on rocks of the same geological formation at Boulder less than one hundred miles south.

Owl Canyon and Vicinity.—Owl Canyon is a steep-walled gorge about a half-mile long cut through the lower members of the sedimentary series, which here dip to the east at an angle of about 15 degrees. The south wall of the canyon, being well shaded, affords an opportunity for the growth of a large number of species of shade plants, while the north wall, exposed to the hot sun, has a typical dry-ridge flora. A continuation of this latter formation is found on top of the ridge where conditions of extreme dryness exist due to lack of soil, exposure to wind and extreme insolation. Owl Canyon and vicinity were frequently visited by Professor C. S. Crandall, who was for a long time botanist of the Colorado Agricultural College, at Ft. Collins. A considerable number of species

collected by him and recorded in the *Flora of Colorado*[1] are known from Colorado only by these collections.

"The Glade."—This is a long north and south valley lying between sandstone ridges varying in height at different points. In width the valley is from one-eighth to one-quarter of a mile. The soil is fine-grained sand with very little lime—well suited to the growth of grasses and sagebrush, but not to trees and shrubs. At the lower end of the "Glade" near Bellevue the ridges are quite low at the sides of the narrow valley, but farther north they are much higher, rising a hundred or two hundred feet above the valley. The vegetation of the "Glade" is that of the lateral valleys generally and is described later under the heading "Valley Grassland Formation."

Plant Formations.—The following plant formations may be distinguished in the area under consideration:

Cercocarpus Scrub Formation.—This is characteristic of the sedimentary rock ridges. Usually a rather close scrub but more open in places where the soil contains lime salts.

Valley Grassland Formation.—Found in the valleys which lie between parallel ridges. There is a mixture of grasses and mountain sage with other herbaceous plants.

Upland Dry Grass Formation.—Small xerophytic grass patches on areas of close-grained soil scattered along the rock ridges.

Canyon Forest Formation.—Mixed forest of deciduous and coniferous trees occupying narrow canyons and stream-banks.

Foothill Sagebrush-Grass Formation.—A xerophytic grassland formation with low-growing species of sagebrush (*Artemisia*) and various perennial flowering herbs.

Foothill Forest Formation.—An open forest on the granite foothills dominated by *Pinus scopulorum.*

Meadow Formation.—Characteristic of poorly drained humus soil along streams, and of low, moist places in the lateral valleys even where there is no running water.

Cercocarpus Scrub Formation.—In naming this formation by its shrub constituent (*Cercocarpus parvifolius*) rather than from the trees (*Pinus scopulorum* and *Sabina scopulorum*) it is well to state that the shrubs form really the all-important feature. The trees are so few that they make little impression to the eye while the shrubs, especially at the line where they meet the Valley Grassland Formation, are very conspicuous. At this place there is often a distinct line where the shrubs stop, with no stragglers at all extending to the fine-grained soil below.

[1] RYDBERG, *Flora of Colorado,* Bull. 100 Colo. Agr. Coll. Exp. Sta. 1906.

This condition, while not universal, is to be considered as the rule. The grass, however, does not stop so abruptly, bunches of it extend all along up through the scrub. Although the shrubs occur only on the tops of the ridges and on the steep slopes, it must not be supposed that their distribution is determined by altitude and its consequent temperature. This is easily proven because the ridges near Bellevue bear the shrubs in great number at an altitude of less than 6,000 ft., which is a thousand feet below the lower shrub line on the ridges east of North Box Elder Falls. Again it is to be noted that patches of grassland occur on level or gently sloping parts of the rock ridges wherever there is an accumulation of soil. Hence it may be said that soil is the controlling factor in determining the limits of scrub and grassland.

The Cercocarpus bushes are about three feet tall and are, as a rule, so closely placed that it is difficult to climb through between them. At any rate one must take a very zigzag course in going among them. Wherever there is an accumulation of soil they are farther apart with bunch grass and mountain sage between them. On ledges of rock containing lime salts the shrubs are often distantly placed giving a truly desert appearance. Pines and cedars when present do not interfere much with the shrubs as these seem able to grow up well under them, being tolerant of some shade. (Views of this formation are shown in Figs. 1, 2, 3, 4, and 5.)

Collections were made from the rock ridges and from the list thus obtained together with field notes a selected list is formulated as giving the more conspicuous or common plants in the spring and early summer. Autumn plants are not known to the writer as the district was visited early in the season. However, some of the perennial plants which come into bloom later could be recognized from vegetative characters. No shrubs occur except Cercocarpus. Pine and cedar are the only trees.

PARTIAL LIST OF THE PLANTS OF CERCOCARPUS FORMATION

DOMINANT SPECIES

Cercocarpus parvifolius

CONSPICUOUS SPECIES

Pinus scopulorum *Sabina scopulorum*

ABUNDANT SPECIES

Various grasses
Artemisia spp.
Townsendia grandiflora
Erysimum asperrimum
Senecio spp.
Tetraneuris acaulis
Tetraneuris lanata
Zygadenus falcatus
Astragalus succulentus
Astragalus crassicarpus
Harbouria trachypleura
Euphorbia robusta
Pentstemon
Cactus missouriensis
Opuntia polyacantha
Lesquerella montana
Lithospermum linearifolium
Aragallus albiflorus
Eriogonum flavum
Grindelia sp.
Frasera speciosa
Leucocrinum montanum
Astragalus drummondii
Phlox bryoides
Aragallus multiceps
Homalobus caespitosus
Pentstemon unilateralis
Mertensia brachyloba

OCCASIONAL SPECIES

Yucca glauca
Chenopodium sp.
Anogra sp.
Carduus sp.
Helianthus petiolaris
Arenaria hookeri
Antennaria sp.

Upland Dry Grass Formation.—This might be described as a part of the valley grassland or it could be called a society rather than a formation. If the facts of the case are understood it will, however, make little difference what name is used. This formation occurs in patches from a few square feet to a an acre in extent scattered along the rock ridges wherever there is an accumulation of soil. Plants of this formation come from the Cercocarpus Scrub Formation, but shrubs and trees are absent. Grasses form a large part of the formation. On exposed south-facing hills *Yucca glauca* is often found with the grass. A list of species would include most of those found in the scrub formation.

Valley Grassland Formation.—As previously noted this occupies the lateral valleys of the sedimentary rock region and extends a short distance up the ridges. It is made up of grasses and various perennial herbaceous plants. In many places there is a considerable mixture of wormwood or mountain sage and this if abundant gives color to the formation when seen at a distance. Probably there are no species entirely confined to this formation since these plants make their way as stragglers up among the Cercocarpus bushes all along. The plants of the valley also get into the foothills and many true foothill plants are

to be found here. Since, however, there are no exposed rocks present the shrubs of the foothills do not obtain a foothold. In the lateral valleys next to the granites where one side of the valley is flanked by granite and the other by sandstone it is interesting to note that such plants as Selaginella do not occur at all. But Selaginella is very abundant on the exposed rocks and coarse talus of the granite hills a hundred feet away. (The valley grassland is shown in Figs. 1 and 5.)

PARTIAL LIST OF PLANTS OF THE VALLEY GRASSLAND FORMATION

Bouteloua oligostachya	*Leucocrinum montanum*
Bouteloua curtipendula	*Eriogonum flavum*
Koeleria cristata	*Artemisia frigida*
Poa spp.	*Artemisia rhizomata*
Bromus porteri	*Artemisia gnaphaloides*
Bromus pumpellianus	*Tetraneuris acaulis*
Agropyron occidentale	*Pentstemon*
Agropyron vaseyi	*Lomatium nudicaule*
Hordeum pusillum	*Antennaria* sp.
Muhlenbergia sp.	*Grindelia squarrosa*

Canyon Forest Formation.—This formation extends along the stream banks wherever there is a narrow canyon and is seen also in the steep gulches which carry only storm water. It is difficult to name any one or even a few species as characteristic of this formation.[1] However, if it were necessary to give a name compounded of the names of characteristic species it might be called the Pseudotsuga-Salix Formation. Along canyon walls with north exposure the Douglas spruce (*Pseudotsuga*) extends down almost to the bank of the stream. Here it is replaced by willows. But many deciduous trees are mixed in with the species mentioned. Canyon walls exposed to the south have very few Douglas spruces but often rock pines, cedars and junipers. These xerophytic plants occur chiefly at the upper part of the wall. Here also may be found such plants as currants, skunk bush (*Rhus trilobata*), Indian currant (*Symphoricarpos*). In places where the stream current is slow and an accumulation of humus is found it becomes possible to distinguish a Stream Bank Marsh Society dominated by sedges but containing such other plants as buttercups, flags, cow-parsnips, shooting stars and

[1] This corresponds roughly to the Populus angustifolia — Salix nuttallii Formation recognized in Boulder County, Colo., by YOUNG, *Bot. Gaz.* 44: 344. 1907.

lungworts. (Figs. 7 and 8 at the end of the article give typical views in the Canyon Forest Formation.)

PARTIAL LIST OF PLANTS IN THE CANYON FOREST FORMATION[1]

PLANTS USUALLY IN SHADED SITUATIONS

Pseudotsuga mucronata	*Ribes valicola*
Acer glabrum	*Clematis ligusticifolia*
Rhus rydbergii	*Clematis eriophora*
Populus tremuloides	*Hydrophyllum fendleri*
Rosa spp.	*Fragaria americana*
Dasiphora fruticosa	*Galium triflorum*
Prunus melanocarpa	*Vagnera stellata*
Opulaster monogynus	

PLANTS IN MORE SUNNY SITUATIONS

Pinus scopulorum	*Symphoricarpos occidentalis*
Sabina scopulorum	*Rhus trilobata*
Juniperus sibirica	*Ribes pumilum*

PLANTS ALONG THE STREAM AND IN WATER

Salix spp.	*Heracleum lanatum*
Populus angustifolia	*Iris missouriensis*
Alnus tenuifolia	*Dodecatheon radicatum*
Carex and other sedges	*Potamogeton* sp.
Mertensia ciliata	*Chara* sp.
Ranunculus macounii	*Spirogyra* sp.

Foothill Sagebrush-Grassland Formation.—At lower altitudes this agrees quite closely with the Upland Dry Grass Formation noted on the sedimentary ridges, but with such differences as have been noted in the paragraph dealing with floras of granite and sedimentary areas.

Foothill Forest Formation.[2]—This is the usual open xerophytic forest of the lower foothills in northern Colorado. Since no point above 8,000 ft. in altitude is included in this study no truly montane conditions are found.[3] The soil of the foothills is a coarse gravel of disintegrated granite. In some places where much washing occurs there is no soil at all and the bare place-rock is exposed. In other places where opportunity exists for the collection of finer particles carried down by the run-off a soil of a few inches or even feet in thickness may be found.

[1] This is a representative list of species selected from a large collection made by the writer and Mr. W. W. Robbins.

[2] Plants occurring in the foothill region but growing along the canyon-sides and creek-banks are discussed under "Canyon Forest Formation." This is about the same in the granite region as in the sedimentary region. Meadow plants of the foothill district are described with "Meadow Formations."

[3] In regard to limits of foothill and montane zones in northern Colorado see a note by the author in *Science*, N. S. 26:642. 1907.

Exposed place-rock offers a foothold for lichens, Selaginella, and various shrubs, while the finer-grained soil furnishes a suitable substratum for grasses and flowering herbs. The rock pine (*Pinus scopulorum*) is the dominant species and no other tree of any importance occurs in the formation. *Sabina scopulorum* is rare. Pseudotsuga can hardly be classed here as it occurs only on very steep north slopes and belongs with canyon plants. Some of the shrubs recorded for the canyons occur in this formation also where they grow on exposed rocks. Throughout the foothill region there are broad-topped plateaus, rounded knolls with broad U-shaped depressions between them and here and there deep canyons. The sides of the hills have a richer flora than the tops owing to different sun exposure, run-off and seepage. Everywhere, except in the depressions, the vegetation is sparse. Probably not over one-fourth of the ground surface is covered with plants and the light brown and pink of the granite gives color to any near view. The pines, however, are sufficiently numerous to make the distant landscape appear green. Rocks with lichens abound and these often appear yellow or reddish-brown or pale green. (See Figs. 6, 9, and 10.)

PARTIAL LIST OF PLANTS OF THE FOOTHILL FOREST FORMATION

DOMINANT SPECIES

Pinus scopulorum

ABUNDANT SPECIES

Selaginella sp.	Various grasses
Pentstemon humilis	*Harbouria trachypleura*

LESS ABUNDANT SPECIES

Geranium fremontii	*Ranunculus* sp.
Scutellaria brittoni	*Aragallus lamberti*
Delphinium sp.	*Lesquerella montana*
Artemisia frigida	*Mertensia lanceolata*
Artemisia gnaphaloides	*Heuchera parviflora*
Drymocallis glandulosa	*Townsendia grandiflora*
Erigeron sp.	*Opuntia polyacantha*
Erysimum asperrimum	*Cactus missouriensis*
Pulsatilla hirsutissima	

SHRUBBY PLANTS NOWHERE ABUNDANT

Ribes pumilum	*Juniperus sibirica*
Edwinia americana	*Cercocarpus parvifolius*
Prunus americana	*Sabina scopulorum* (a tree)

Meadow Formation.—The North Box Elder has an old and well-established drainage area as is shown by the places where its canyon

spreads out and permits the formation of broad meadow land. Here the stream accompanied by a fringe of trees and shrubs takes a meandering course. The meadows studied were at an altitude of about 7,000 feet and hence belong definitely to the foothill zone. In fact the plants of rocky hills and slopes are as above noted distinctly of the foothill type and not montane. The meadow plants, however, are much like those of the meadows in the montane zone. The most characteristic plant is *Polygonum bistortoides*, a species which extends up to the alpine summits of the main range. The willows along the stream-banks also are species which range up rather than down. This coming down of plants of colder regions into the lower altitudes is to be expected in meadows where the soil does not warm up as in dry situations. The same condition of affairs is well known in the glacial ponds and swamps of the Mississippi region.

Partial List of Plants of the Meadow Formation

Dominant Species

Polygonum bistortoides	Various sedges and grasses

Less Abundant Species

Mentha penardi	*Mertensia ciliata*
Collinsia parviflora	*Mimulus langsdorfi*
Dodecatheon radicatum	*Achillaea lanulosa*
Plantago tweedyi?	*Fragaria americana*
Equisetum arvense	*Viola canadensis rydbergii*
Heracleum lanatum	

Summary.—For purposes of reference the material of the foregoing pages may be summarized briefly. The paper gives an account of a botanical reconnaissance of a part of Larimer County in northern Colorado. The district embraces about 150 square miles and includes foothill country to the west and a region of sedimentary ridges and valleys to the east. Altitudes vary from 5,500 to 7,500 ft. The physiography, climate and soil of the area are discussed with reference to the growth of plants and certain localities of special botanical interest mentioned. The plant formations are then considered and classified as follows: Cercocarpus Scrub Formation, Valley Grassland Formation, Upland Dry Grass Formation, Canyon Forest Formation, Foothill Sagebrush-Grassland Formation, Foothill Forest Formation, and Meadow Formation. There is a discussion of the limits and character-

istics of each of these formations and a representative list is given of species found in each. Probably the most interesting part of the paper is the account and discussion of the Cercocarpus Scrub Formation on the rock ridges. This formation is confined to rocky places and is replaced by grassland in the valleys. The line of contact between scrub and grassland is often very sharply marked. The controlling factor which determines the distribution of the scrub and grassland formations is the soil quality and not rainfall or temperature. A number of illustrations are used to show the characteristic features of the region and the various formations studied.

FIG. 1.—View near Owl Canyon looking north. The sedimentary ridges are seen sloping to the east. Cercocarpus bushes cover the steep slopes but the valley grassland lies between the ridges. From a photograph by the author.

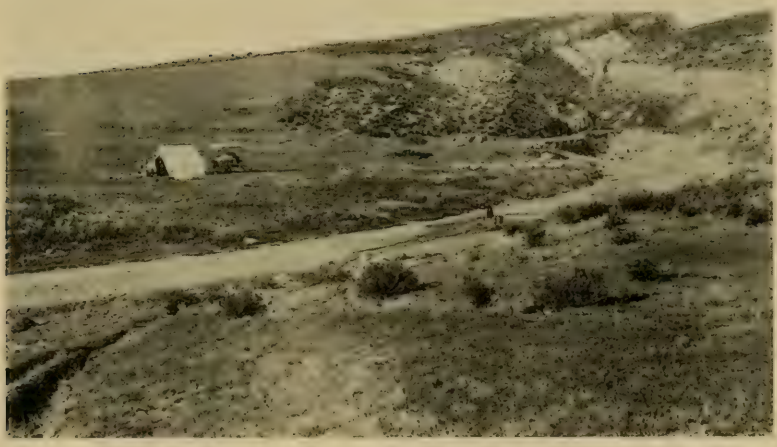


FIG. 2.—View at the lower end of Owl Canyon, showing Cercocarpus bushes on the higher parts of the ridges; grassland elsewhere. Photograph by Mr. G. S. Dodds.

FIG. 3.—A sedimentary ridge near Owl Canyon (looking north). Cercocarpus bushes are seen on the slopes but not in the fine-grained soil below.

FIG. 4.—View of a series of sedimentary ridges east of Box Elder, Larimer County, Colo. The ridges are covered with Cercocarpus. Note the very sparse growth of rock pine. From a photograph by the author.

Fig. 5.—View looking east across the valley of Sand Creek, near Box Elder, Larimer County, Colo. The ridges are dotted with Cercocarpus bushes. Deciduous trees of the valley along the creek belong to the Canyon Forest Formation. Cattle are seen grazing in the Valley Grassland. Photograph by Mr. G. S. Dodds.

Fig. 6.—Rounded ridges of granite with rock pines on the tops and steep slopes, the open Foothill Forest Formation; grassland in the valleys. In the foreground is Box Elder Creek, fringed at this point with willows and alders. From a photograph by Mr. G. S. Dodds.

FIG. 7.—A steep canyon in the sedimentary rocks near Box Elder. At the left are willows and narrowleaf poplars. To the right, on the sloping sides of the canyon, are junipers and cedars with various deciduous shrubs. Douglas spruce and rock pine in the background. A typical view in the Canyon Forest Formation. Photograph by the author.

FIG. 8.—Looking east along a gulch in the sedimentary region east of Box Elder, Larimer County, Colo. Douglas spruces on shaded slopes with willows and poplars in the lower parts of the canyon near the water. The ridges in the distance are covered with Cercocarpus. Photograph by Mr. G. S. Dodds.

Fig. 9.—View in the foothill region (Foothill Forest Formation) showing scattered rock pines and sparse vegetation of bunch grasses and various flowering herbs. In the lower places between the rolling hills are found a few representatives of the Canyon Forest Formation, chiefly currants, Indian currants and choke cherries. Photograph by the author.

Fig. 10.—Foothill Forest Formation in the granite foothills near Box Elder. Larimer County, Colo. At this point a large amount of bare rock is exposed where lichens and Selaginella find a foothold. From a photograph by the author.

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A COLORADO RAILROAD POOL

By John Burton Phillips

A railroad's power over the rates to be maintained in any section of territory is determined by its ability to control all the transportation facilities existing in that section of the country. In so far as the terminals are common points from which the shipper has the choice of route in sending out his consignments, no one railroad alone can long control the situation as to the rates to be charged without an agreement with the other roads. This is the reason for the existence of railway pools. When the locality to be served by the railroads is far removed from the eastern parts of the country where there are numerous rail and also many water facilities in the matter of transportation, and when the remote locality is served by comparatively few railroads and no water transportation, the conditions favoring a powerful pool are propitious. It is also easier to maintain a railway pool when there is no likelihood of its being interfered with by ocean or inland water transportation. Therefore, the situation of Colorado, favorable in both these respects to pooling agreements, early made the citizens familiar with these railroad combinations, and placed their prosperity in great degree in the control of the men at the head of the great transportation systems.

A railroad pool is commonly thought of as an agreement according to which each road binds itself to maintain a certain rate agreed upon in the conference. The other matters with which pools concern themselves are not usually thought of as of great importance, nor is the power of the pool to control the entire development of a state generally understood. It is therefore interesting to know the effect of the pool formed by the railroads which first entered the state of Colorado—a pool, however, which was not formed primarily for the purpose of arranging rates.

On March 22, 1880, a tripartite agreement was made between the three leading railroads of the state of Colorado. They divided up the territory alloting certain portions to each of the parties to the contract and agreed not to build railroads there nor to take freight or passengers from

nor in any way connect with any railroads that might be built in these particular sections of territory. The territory thus divided among the three parties to the contract comprised the state of Colorado and the northern part of New Mexico. The parties to this agreement were the Union Pacific, Atchison, Topeka a id Santa Fe, and Denver & Rio Grande.

The facts in the case seem to have been these. The Denver and New Orleans Railroad Company operated a line of railroad from Denver to Pueblo. The Denver and Rio Grande also had a road between the same two points. The Atchison, Topeka and Santa Fe Company had a line from Kansas City to the Colorado state line and from there to Pueblo leased the line of the Pueblo and Arkansas Valley Railroad. It was 634 miles from Kansas City to Pueblo over the two railroads. When the Atchison, Topeka and Santa Fe thus reached Pueblo, it had no connections of its own with Denver. The Denver and Rio Grande was built from Denver to Pueblo but the gauge was different from that of the Santa Fe. The latter railroad accordingly made an agreement with the Denver and Rio Grande. A third rail was ultimately to be put down on the track of the Denver and Rio Grande to enable the Santa Fe to get its cars into Denver. This agreement was made in 1879. According to the terms of this contract the Denver and Rio Grande was to receive compensation at the rate of one and one-half miles for every mile hauled. Later in March, 1880, the tripartite agreement mentioned above was entered into. By 1882 the Denver and New Orleans Railroad had reached Pueblo and the general superintendent made a request of the general manager of the Atchison, Topeka and Sante Fe for the establishment of an agreement whereby an interchange of business might be brought about and through traffic over the Denver and New Orleans Railroad established. This request was refused. The Atchison, Topeka and Santa Fe declined to receive or deliver freight or passengers at the junction of the Denver and New Orleans Railroad, or give through bills of lading, or sell or receive through tickets or check baggage over that road. The Atchison, Topeka and Santa Fe Company charged more for tickets east from the junction than it received on through tickets east sold in Denver by the Denver and Rio Grande.

This refusal of the Santa Fe to carry to or from Denver and points between Denver and Pueblo except in connection with the Rio Grande at the same price was equivalent to saying to the public which railroad it should use and was supposed at once to be a plain violation of the constitution of the state. The matter was taken into court by the Denver and New Orleans Railroad. In defense of its refusal to deal in any way with this latter road the Santa Fe stated that it had made a contract with the Denver and Rio Grande for a through line from the Missouri River to Denver and that this contract was of great advantage to itself, and that this advantage could not be maintained except by keeping this contract requiring the exclusive dealing between the parties thereto.

In his decision Judge Hallett said this answer did not explain the true nature of the contract. The contract was an agreement between the Union Pacific of the first part, the Santa Fe and its leased lines of the second part, and the Rio Grande of the third part, for a division of traffic and territory in Colorado and New Mexico. When the contract was made, March 22, 1880, these three companies owned or controlled all the railroads in Colorado and the northern half of New Mexico. By the agreement, says Judge Hallett, they assumed to divide the country and allot to each of the parties its separate portion for the purpose of building new railroads. The parties were each bound not to trespass upon the territory of the other parties as defined in the agreement, and each stipulates with the other that it will not "voluntarily connect with, or take business from or give business to, any railroad which may be hereafter constructed" in the territory of the other. Having thus settled the matter of railroad building, the arrangements for a division of the traffic are as follows:

SECTION 4. All traffic to and from the Missouri River, and all competitive local traffic, both passenger and freight, to and from the territory south and west of Denver, reached by and covered by the Denver and Rio Grande Ry. Co. or Denver, South Park and Pacific Ry. Co., and lines constructed or to be constructed by them or either of them, shall be pooled between the Union Pacific Ry. Co. and the Atchison, Topeka and Santa Fe Ry. Co., one-half to each; also all traffic to and from the Missouri River, and to and from competitive local points, both freight and passenger to and from Denver, shall be divided, three-fourths to the Union Pacific Ry. Co. and one-fourth to the Atchison, Topeka and Santa Fe Ry. Co., each company in each case to

deduct 40 per cent. as cost of operating; it being understood and agreed that all local business, both passenger and freight, to and from the Denver, South Park and Pacific Railroad Co. east of and including Weston station, shall be treated as Denver business and divided accordingly. It is also understood that the party of the third part is not to do any through business to and from Trinidad, or to and from New Mexico via Trinidad or El Moro.

SECTION 5. That as long as the parties of the second part, and each of them shall keep the agreements on their behalf herein contained, one-half of all the traffic, both passenger and freight, originating in Colorado and also in New Mexico at points as far south as the party of the third part is authorized to build under this agreement and coming or delivered to the party of the third part for transportation over any of the lines of the party of the third part, constructed or promoted by it, or coming or delivered to it for transportation from lines connecting with it and destined for points east of the line between Denver and El Moro and said line extended northerly and southerly, shall be delivered at South Pueblo for transportation over the railroads controlled by the party of the second part and the other half at Denver, for transportation over the railroads controlled by the party of the first part, as far as the party of the third part can legally control such traffic. It is further agreed that as to all traffic, both freight and passenger, interchanged between the party of the third part and the other parties hereto, to and from Denver via South Pueblo, and from and to South Pueblo via Denver, the party of the third part shall be entitled to and shall prorate with the other parties at the rate of one mile and one-half to one; that is to say, shall be entitled to and shall share in the distribution of such total fare and freight moneys for each mile of actual haul done by the Denver and Rio Grande Ry. as if the same were carried by it one mile and a half; but the allowance of the extra mileage shall in no event exceed local rates and in case of any more favorable *pro rata* being given to the party of the first part, the same shall be given to the party of the second part. It is further agreed that the rates between South Pueblo and Leadville and between South Pueblo and all other points west of Pueblo shall be as low as between the same points and Denver under any and all circumstances, and the party of the third part shall not discriminate against the parties of the second part in respect of cars and other facilities for the transfer of freight or persons.

SECTION 6. In order to enable the party of the third part to carry out its obligations under the above article, and for its protection it is further agreed that the parties of the second part shall, as long as the party of the third part shall keep the agreement on its behalf herein contained, deliver at South Pueblo for transportation and traffic, passengers or freight destined from points east of the said line of the party of the third part to points on its line, constructed or to be constructed or promoted by it or connected with it, in Colorado and also in New Mexico, to points on its line as far south as the party of the third part is authorized to build under section two of this agreement, and shall not deliver to, or cause to be transported over or voluntarily

receive the same from, any other line of railroad in the territory named than that of the party of the third part, as far as the said parties of the second part can legally control the same; and than any agreement or understanding of the parties of the first and second parts with each other, or of both or either or any of them, with any competing railroad for division of the business or territory or earnings that might divert business which would otherwise, under this agreement, pass over the lines of the party of the third part, shall provide for securing to the party of the third part, a proportionate benefit on the mileage basis stated in article five, for not less than one half of the southern and western business, and one fourth of the Denver business, as provided in article four of this agreement: provided that this shall not prevent the party of the second part from making an agreement or understanding with the Atlantic and Pacific Ry. Co. without incurring any liability to the party of the first or third parts.[1]

Concerning this remarkable contract Judge Hallett says, "It is enough to say that it is a conspiracy to grasp commerce and suppress the building of railroads in two great states."[2] He points out that such contracts had previously been declared illegal.[3] By this contract the Rio Grande also agreed "not to do any through business to and from Trinidad, or to and from New Mexico via Trinidad or El Moro." Judge Hallett further says this was renouncing its duty to the state by declining part of the business at Trinidad. One of the worst features of the contract according to the decision was the provision by which the parties agreed not to connect with or take business from or give business to any railroad which may be constructed in Colorado or New Mexico after its date (March 22, 1880). By this agreement a monopoly was sought to be perpetuated. Judge Hallett therefore decided that this agreement was void as a contravention of the provisions of the state constitution prohibiting discriminations in charges and facilities by railroads.[4] Judge Hallett's decision prescribed rules for the dealings of the two railroads compelling the Santa Fe to give the same facilities to the Denver and New Orleans as to the Denver and Rio Grande except as to the issue of through bills of lading, through checks for baggage, through tickets, and probably the compulsory interchange of cars. Both companies at once appealed from this decision, the Santa Fe because

[1] 15 *Federal*, 653, 654. [2] *Ibid.*

[3] 3 *Roberts* (N. Y.), 411; 5 *Denio*, 434; 4 *Denio*, 349.

[4] 15 *Federal*, 653. Constitution of Colorado, Art. XV, secs. 4, 5 and 6.

it was against them and the Denver and New Orleans because it did not afford them the complete relief for which they had sought the courts.

The general effect of the decision on the public mind was to encourage the belief that at last a way had been found whereby the railroads might be compelled to heed the interests of the citizens. The *Denver Law Journal* had a long editorial on this decision and pointed out that more legislation was not necessary for the purpose of controlling railroads and that this matter might safely be left to the courts. It said,

> We cordially urge an attentive and careful perusal of it in connection with the opinion of Judge Baxter, of the United States Circuit Court of Ohio, to be found in our last number, upon every railroad lawyer and official. From them they can learn that the use of money and influence with our legislators is a waste of time and money, for the courts have ample power to put on the brakes when the railroad companies undertake to travel faster than the law permits, and that they can do so effectively. We are not in favor of legislating against railroads, or preventing them from using their legitimate powers most beneficially to themselves, but we believe the time has come when every railroad official should post conspicuously in his office, so that he cannot fail to see it: "Railroad companies are the servants, not the masters of the people. The people have rights which railroad corporations will be compelled by the courts to respect."[1]

Notwithstanding the exultations of the *Law Journal*, the people were soon to begin that slow process of finding out the limitations of the courts in the matter of controlling great industries, limitations which it has remained for the generation of our day to realize fully.

As soon as this decision of the court was announced, the officials of the three principal railroads concerned met to arrange a pool so that the Denver and New Orleans Railroad might be prevented from getting any benefit from the decision of the court. In order to accomplish this it was decided that the Rio Grande should carry freight between Denver and Pueblo at five cents a cwt. for all classes, and passengers for seventy-five cents each. The parties to the contract and pool continued to support this policy for about two years. It was suicidal for the Rio Grande, for at the end of that period that road went into the hands of a receiver. The receiver as a court officer restored the rates to a reasonable price, which was about half what they were before 1883. The

[1] *Denver Law Journal*, March 6, 1883.

members of the pool issued notices to railroads both east and west requesting them not to bill goods nor ticket passengers over the Denver and New Orleans Railroad notwithstanding the fact that that company had always paid its dues arising from such business. The Burlington Railroad was forced to join in this pool.

In the complaint made before the railroad commissioner in September, 1885, it is stated that the Burlington refused to do any business whatever with the Denver and New Orleans Railroad. It would not transfer freight to that line nor treat with its agents as the representatives of the company. It would not allow its own cars to go over the tracks of the Denver and New Orleans Railroad, as was at that time an old custom among carriers, and it had torn out the track connection between it and the Denver and New Orleans which connection had been laid by the latter company.[1] There was then no connection between the lines although the Burlington crossed three tracks of the Denver and New Orleans. It is said that the Burlington feared that failure to conform to the wishes of the parties in the pool would bring upon it the evils of a rate war and such discrimination as the Denver and New Orleans was at that time suffering.[2]

The Supreme Court of the United States, to which the appeal had been taken, decided on March 3, 1884, that the sections of the Colorado constitution upon which Judge Hallett had relied in making his decision were not effective without special legislation and that therefore his decision was unconstitutional.[3] The following legal principles were enunciated:

A common carrier is not bound to carry except on his own line.

In case a common carrier elects to carry beyond his own line, he has the right to select his own agencies.

Unless required by statutory regulation, transportation companies are not required to form a continuous line and do a connecting business.

Companies engaged in the transportation business are not obliged to interchange and haul each other's cars, nor honor each other's tickets, bills of lading, baggage checks, nor deal with nor recognize each other in any manner as transportation companies.

[1] *Report of the Railroad Commissioner, Colorado*, 1885, p. 542.
[2] *Memorial for the Passage of Senate Bill No. 1*, by John Evans, Denver, February 18, 1885.
[3] 110 *U. S.*, 667.

This was the strict *laissez-faire* doctrine applied to transportation.

The decision was a triumph for the three railroad companies. The old agreement was continued and the result was greater hardship for the Denver and New Orleans Railroad.

The effect of this agreement on that railroad had greatly reduced its traffic and earnings. In 1885 its expenses were 117% of its earnings and in this computation interest on the bonds is not included.[1] If this expense were added, the showing would be much more unfavorable. The financial distress which ensued was so great that the company could not maintain its roadbed and track in an efficient condition as is required in good railroading. Little had been done since the road was finished in 1882 except ballasting, surfacing and lining, things necessary after a roadbed has been constructed. By 1885, the roadbed was beginning to go down and repairs were greatly needed. It was not sufficiently watched even by section hands. The company reported only fifteen section men employed for the entire line of the road, 145 miles, one man to nine and two-thirds miles. The railroad commissioner states that this force of men could not keep more than fifteen miles of the road in order. At the time of the commissioner's inspection, there were found but three section hands employed on the entire line. The commissioner reported that as long as the road remained frozen there was not so much danger but he warned the public in his report that as soon as the warm weather came, there would be great danger.[2]

The promoters of the Denver and New Orleans Railroad made one more effort to save themselves from the ruin which they saw was sure to befall them at the hands of the pool companies. They prepared and introduced a bill in the legislature of 1885 which sought to correct the supreme-court decision, and enable them to get a fair share of the transportation business. The bill forbade the consolidation of railroads and also forbade a railroad company to reduce the rates below remunerative charges for the purpose of injuring another railroad. This bill was introduced in both the senate and house, and both bills were referred to the committee on corporations. The design of the bills was to enforce

[1] *Report of the Railroad Commissioner, Colorado*, 1885, p. 27.

[2] *Ibid.*, p. 52.

sections 4, 5 and 6, of article 15 of the state constitution. These sections are as follows:—

SECTION 4. All railroads shall be public highways, and all railroad companies shall be common carriers. Any association or corporation organized for the purpose shall have the right to construct and operate a railroad between any designated points within this state, and to connect at the state line with railroads of other states and territories. Every railroad company shall have the right with its road to intersect, connect with or cross any other railroad.

SECTION 5. No railroad corporation or the lessees or managers thereof shall consolidate its stock, property or franchises with any other railroad corporation owning or having under its control a parallel or competing line.

SECTION 6. All individuals, corporations and associations shall have equal rights to have persons and property transported over any railroad in this state, and no undue or unreasonable discrimination shall be made in charges or in facilities for transportation of freight or passengers within the state, and no railroad company, nor any lessee, manager or employee thereof, shall give any preference to individuals, associations or corporations in furnishing cars or motive power.[1]

The committee listened to many arguments both for and against the bill. A lengthy memorial was presented by Ex-Governor Evans praying for the passage of the proposed law. Among the advantages enumerated in the memorial that would result from the passage of the bill are the following:

1. The state would be emancipated from the grip of the three railroad companies and some railroad development allowed.

2. The city of Trinidad might build a railroad to El Moro and connect with the Rio Grande. This it was not allowed to do as long as the existing situation continued.

3. The owners of the coal lands at Cañon City would be enabled to ship their coal and thus be spared the expense of building a railroad from Little Buttes to the Denver and New Orleans Railroad.

4. Cañon City would get a broad-gauge railroad. This was probably in the schemes of development contemplated by the Denver and New Orleans Railroad.

5. Leadville would then get competition in coal prices as at that time other dealers were shut out except the one favored by the railroad and this one dealer had a monopoly of the market.

[1] *Constitution of Colorado*, Art. XV, secs. 4, 5 and 6.

6. Ouray citizens would have a chance to build a railroad to Montrose and have connection with the Rio Grande. Some time before this privilege had been refused by the Rio Grande to the promoters of an independent company and the scheme had been dropped.

7. Lake City would be able to build a railroad to the Rio Grande and secure an outlet for its ores.

8. Midland County could also secure railroad connection at Aspen.[1]

Toward the close of the session, the committee filed a memorandum stating their position in regard to the proposed law. The following is the substance of this memorandum:

1. No grievance is complained of under sec. 4 of Art. XV of the constitution.

2. Sec. 5 forbids the consolidation of railroads and this bill would indirectly violate the spirit of that section by allowing combination. The Denver and New Orleans was the only railroad asking for this law, and it appeared to the committee that this railroad did not care to continue the competition with the Rio Grande. Before the competition the fare from Denver to Pueblo had been $10 and after the competition and in the absence of legislation such as this bill provided this fare had been reduced to 75 cents. This rate had lasted for about two years and had finally been fixed at $5. Freight rates had also been reduced in like proportion. The committee therefore thought this sort of competition would be good for the state. This bill also proposed to prevent any railroad company or person from reducing rates below remunerative charges for the purpose of injuring another railroad under a penalty of $20,000 fine. This, said the committee, would prevent railroads from competing with each other and had it been in operation when the Denver and New Orleans Railroad was completed, would have prevented the Rio Grande from reducing as that railroad would certainly not have been willing to incur the heavy penalty which the proposed law provided in such cases. The committee also stated that the bill would prevent any competition between the Rio Grande and the Denver and New Orleans at Pueblo for business brought west over the Santa Fe. The committee said rates would not be reduced but on the contrary would

[1] *Memorial for the Passage of Senate Bill No. 1*, by John Evans, Denver, February 18, 1885.

be advanced. It would be impossible for the Santa Fe to make a contract with one road which it would not be obliged to make with every other parallel road, and hence freight rates would have to be put up high enough to maintain two roads instead of one when one road was all that was needed to do the business. The cost of traffic would in this way be increased and the freight would have to pay it.

3. The legislation proposed by this bill was not required by sec. 6 of Art. XV of the constitution of the state. Unreasonable discrimination only is prohibited by the common law and the constitution as stated in the decision of the United States Supreme Court in the matter of these two railroads.[1] The committee held that the bill sought to prevent a reasonable discrimination. It did not seek to reduce rates but aimed only to put the Denver and New Orleans Railroad in the same position as the Denver and Rio Grande with regard to through traffic. The committee said this was manifestly impossible till it was shown that the roads were in the same relative position as to ability to render the service. The committee also quoted from the law that had been but recently passed by the legislature and which provided that "No railroad company shall without the written approval of said (railroad) commissioner charge, demand, or receive from any person, company, or corporation, for the transportation of persons or property, or for any other service, a greater sum than it shall . . . . charge, demand, or receive from any other person, company, or corporation, for a like service, from the same place or upon like conditions, and under similar circumstances."[2] This act the committee thought answered both the common law and the constitution of Colorado.

4. It was not claimed according to the memorandum of the committee that this bill would if enacted into law increase in the slightest degree the freight traffic of the state. It was considered a scheme to take traffic from the Denver and Rio Grande and give it to the Denver and New Orleans—a railroad which had not earned the business. The bill would also allow foreign companies to build to the Colorado lines of railroad and force a connection with them in order to reach the commercial centers.

5. A railroad company, to do business beyond its own terminus,

[1] 110 *U. S.*, 667. [2] *Laws of Colorado*, 1885, p. 309, sec. 7.

cannot be required to contract for through business with all roads and should not be asked to. The proposed bill sought to break up an established through line.

6. The claim that freight consigned to shippers over the Denver and New Orleans was diverted from that road and shipped over the Rio Grande was not substantiated. A law against this sort of thing already existed. No freight need be paid in such cases.

7. The bill was experimental legislation and therefore not to be recommended. Nothing of this sort in legislation was in existence.

8. The title of the bill was a misnomer according to the opinion of the committee. The bill, so it was charged, was not intended to enforce the constitutional provisions, but aimed to punish shippers rather than carriers as it sought to prevent the Santa Fe from making the best bargain it could in getting its goods from Pueblo to Denver. From Pueblo to Denver the Santa Fe was a shipper and not a carrier. In closing their discussion the committee say, "The constitutional doctrine prohibiting railroads from discriminating between shippers is turned end for end, and is made to apply so as to prevent shippers from discriminating between railroads."[1]

The committee reported that they could not see how the bill would enforce either of the sections of the state constitution which it was designed to enforce and on March 20, 1885, filed their report recommending that the bill be indefinitely postponed. There was also a minority report recommending that the bill pass after certain amendments had been made in accordance with the suggestions of members of the committee. One of these was that the law apply to traffic wholly within the state. This looks as though some member of the committee had a notion of the control of inter-state commerce given to Congress by the federal Constitution, but at that time Congress had not asserted this control in the matter of railroad regulation. The majority report of the committee was adopted and the bill indefinitely postponed.[2] During the same month the Denver and New Orleans Railroad having reached the bottom of the financial abyss was sold under foreclosure. It was later reorganized and in the course of time became a part of the Union Pacific system. It is now the Colorado and Southern.

[1] *Senate Journal*, 1885, p. 1056. [2] *Ibid.*, 1885, p. 1071.

THE DOCTRINES OF THE ORPHIC MYSTERIES, WITH SPECIAL REFERENCE TO THE WORDS OF ANCHISES IN VERGIL'S SIXTH *AENEID* 724–51[1]

By George Norlin

The sixth book of the *Aeneid* is a composite picture drawn mainly from Greek models. Popular descriptions of the lower world in the Greek epic, philosophical ideas, and the fantastical beliefs of the mystery cults are here combined into a splendid, though not altogether harmonious effect. It is easy enough, in spite of Eduard Norden's defense[2] of Vergil's consistency, to point out the confusion which has resulted from this mixture of discordant elements; but the thesis of Vergil's carelessness has, perhaps, been pushed too far. Where inconsistencies appear to exist the editors have been too prone to dismiss them with the ready explanation that the poet had no chance to work over and revise this difficult attempt to fuse into a consistent whole conceptions borrowed from such different sources.

It is the purpose of this paper to attempt an interpretation of the most troublesome passage of all, lines 724–51, as it stands in the MSS, without resorting to the usual *tour de force* of deleting a portion or rearranging the lines.[3]

The discovery of the new Orphic verses,[4] mainly in southern Italy, inscribed on thin gold plates buried with the dead, has served to recall the attention of scholars to the mystic ideas of the Orphic-Pythagorean psychology and eschatology, with the result that the field has been reworked, and difficulties have been cleared away; and among them some of the harder problems of the sixth book of the *Aeneid* have been,

[1] Reprinted from *The Classical Journal*, Vol. III, No. 3, January, 1908, with permission of the editor.

[2] *Hermes* XXVIII. 372 ff. and XXIX. 313 ff.; later his edition of *Aeneid*, book vi.

[3] Following, and supplementing, the general line of Norden's explanation, pp. 16 ff. of his edition, but differing from it in an important particular.

[4] Collected with text, translation, and commentary by Gilbert Murray in the appendix to Harrison's *Prolegomena to the Study of Greek Religion*.

in some degree at least, illuminated.[1] The study of these new verses, some of which date from the fourth century B. C., has at any rate proved that the Orphic ideas of the soul and its destiny which are found in late writers like Proclus, highly colored though they are with the Neoplatonic mysticism, come from an early Orphic source, probably the same general source as the newly discovered Orphic lines. It has served, furthermore, to prove the close kinship between the mystic ideas in Empedocles, Pindar and Plato, and to establish the plausibility, if not the certainty, of the thesis that these authors drew their notions of metempsychosis and eschatology from a common Orphic source, perhaps an Orphic-Pythagorean "Book of the Dead," and that to the circle of ideas which came from this source Vergil owes some of the features of his lower world.[2]

In order to arrive at a view-point from which to examine more satisfactorily the Vergilian lines in question, I propose to pass in brief review the principal notions of the mystic teaching regarding the soul and its destiny which must have been familiar to Vergil.

First is the mystic doctrine of original sin involved in the characteristic myth of the Orphic god, Dionysus-Zagreus. Zagreus, the son of Zeus, is slain by the wicked earth-born Titans and devoured by them. Zeus smites the Titans with the thunderbolt and consumes them with his lightning. From their ashes springs the human race. These ashes contain the essence of the earth-born Titans who rebelled and sinned against Zeus and of the divine Zagreus whom they devoured. Mortals are therefore compounded of the earthly and the heavenly, the carnal and the spiritual, the pure and the impure.[3] In their origin from Zeus, through his son Zagreus, they are divine and immortal;[4] but as they contain also the earthly, Titanic element, they inherit the guilt of the

[1] Rohde *Psyche*, in the revision of 1898; Dieterich *Nekyia;* Maas *Orpheus;* Gruppe, article on "Orphic Eschatology" in Roscher's *Lexikon;* Norden's learned edition of the sixth book of the *Aeneid;* Harrison's *Prolegomena to the Study of Greek Religion;* Weil "La croyance à l'immortalité de l'âme" in *Journal des savants*, April, 1895, published also in his volume of *Études sur l'antiquité grecque* (Paris, 1900).

[2] The general view of Weil; see especially pp. 60, 93. Less conservative are Dieterich, p. 198, and Norden *Aeneid* vi, p. 20.

[3] Lobeck *Aglaophamus*, p. 565; Rohde *Psyche* II, p. 119; Weil *loc. cit.*, p. 38.

[4] In the gold tablets the soul's claim to salvation is based on this divine origin. See especially the Petelia and the Caecilia Secundina tablets. Cf. Pindar, fr. 131.

Titans, their "deeds unrighteous," and are doomed to "suffer the suffering" and do penance for their "ancient sin."[1]

What, then, is the nature of the punishment? The answer is the Orphic-Pythagorean doctrine of metempsychosis. By the law of the Orphic Fate the soul is condemned to an indefinite series of incarnations.[2] It must again and again take on a perishable body. "Clothed in a strange garment of flesh," it must wander in this "meadow of woe," "this roofed-in cave," "this cheerless realm of wrath and death and throngs of dooms and loathsome disease and decay."[3] Each existence on earth is a punishment, each body a tomblike prison[4] in which the soul is exiled from its rightful home and deprived of its fellowship with the gods.[5]

This wandering of the soul from one existence to another, from a higher to a lower, from a lower to a higher, is conceived as a cycle or wheel of life, κύκλος, τρόχος.[6] In this cycle it is theoretically possible that the soul may fall indefinitely until it is born into the lowest form of earthly existence, or rise indefinitely until it becomes a god; but the chances are that it will not rise to any height, because the ancient guilt tends to beget an endless brood, and so the series of earthly punishments and imprisonments goes on and on. The cycle of rebirths is then for the majority of indefinite duration; or, when any limit is set to it, it is a minimum of ten thousand years.[7]

So far the doctrine is simple enough, but the idea of reward or punishment by progress or retrogression in the earthly life is complicated with the notion of reward or punishment in the lower world between incarnations, and with that of eternal bliss or eternal pain.

If the life on earth has been one of signal wickedness and the soul is beyond cure, it is sent to the torments of the damned in the lowest

[1] See Compagno tablet *b*, Timpone Grande tablet; Pindar, fr. 106, and Weil's commentary, p. 36.

[2] Abel *Orphica* 222, 223; Empedocles (Stein) 383, 384.

[3] Empedocles 402, 381, 391, 385–87.

[4] Plato *Crat.* 400 C. Cf. *Phaedo* 62 B and Verg. *Aen.* vi. 733.

[5] Empedocles 381.

[6] Abel *Orphica* 225, 226. This is the κύκλου βαρυπένθεος ἀργαλέοιο of the gold tablets. Cf. *perfecto temporis orbe* of *Aen.* vi. 745 and *rota* in *Aen.* vi. 748.

[7] Plato *Phaedr.* 249 A; in Empedocles, 30,000 seasons. See Dieterich *Nekyia*, p. 119, and Rohde *Psyche* II, p. 379, n. 3.

depths of Hades, where its release from the cycle consists in the more terrible fate of endless suffering.[1] Of the other souls, the good are sent for a time to an Elysium in Hades, while the unworthy but not beyond hope, are sent to a place of punishment. The temporary sojourn in Hades is one of purification. Those in the place of punishment are purified through suffering; those in Elysium, apparently through companionship with the good and a foretaste of greater joys to come.[2] The purification in Hades goes on for a considerable length of time—definitely, a period of a thousand years.[3]

The purpose of the mysteries was, naturally, to exempt their votaries so far as possible from the cycle of exile and to reconcile the soul with god.[4] They could at least promise to the mystic who had submitted himself to the rites of initiation, the ceremonies of purification and the Orphic rules of life, that between incarnations he would not suffer punishment, but would pass the time in comparative joy in Elysium. But there were degrees of virtue within the Orphic sect. To the chosen few who in each life kept their soul from guilt they promised complete purification and release from the "wearisome cycle" after three lives of the body and three purgations in the Elysium of Hades.[5] When at length the last penance is done and the last purgation is accomplished, the soul recovers its pure divinity, regains its lost estate and goes to dwell forever with the gods.[6]

These are the main ideas of mystic thought as they are gathered from Orphic fragments, from Empedocles, Pindar and Plato. Whether they are taken from one common source, an Orphic-Pythagorean poem,

[1] Plato *Phaedo* 113 E; *Repub.* 615 D, E; *Gorg.* 525 C; Pindar *Ol.* 2. 74.

[2] For Elysium as a place of purgation see Maas *Orpheus* 231, Abel *Orphica* 231, where the good are purified and receive a "milder fate," ἐν καλῷ λειμῶνι, βαθύρροον ἀμφ' Ἀχέροντα. Corresponding to this "fair meadow" is the Elysium of Pindar, fr. 129 (Rohde *Psyche* II, pp. 210, 211), and Plato's *Vorparadies* in the heavens, *Phaedr.* 249; *Repub.* at end.

[3] Plato *Phaedr.* 249; Verg. *Aen.* vi. 748.

[4] Abel *Orphica* 266.

[5] Pindar *Second Olympian* 75 ff., according to Rohde's interpretation; Plato *Phaedr.* 249 A—where the Elysium of Hades is replaced by an intermediate heaven. Cf. Claudian *In Rufin.* ii. 491 ff. The gold tablets furnish no evidence on this point, but see Gruppe's suggestion in Roscher, p. 1127.

[6] In the Compagno tablets the soul is freed from its mortality and is pronounced a god. It is sent ἐς ἕδρας εὐαγέων; in the Neoplatonic language of Proclus, πρὸς τὸ νοερὸν εἶδος, Abel *Orphica* 226; probably to Zeus or the "Starry Heaven," whence came its divine, immortal essence. See Rohde *Psyche* II, pp. 130, 131. So also Empedocles 449–51; Plato *Phaedr.* 247; and in more popular language, Pindar *Ol.* 2.71.

with which, or with some abstract of which, Vergil was acquainted, may, in spite of Dieterich and Norden, be regarded as still an open question. But that these notions in the form in which I have reviewed them formed a part of the literary inheritance of Vergil admits of little doubt.

But to explain the Vergilian passage in question we must add an element drawn from another source, from Stoic pantheism in its more popular form, as it is reflected in Cicero and the Roman writers of his time and later—the doctrine that the soul is a spark from the divine ethereal fire which pervades and rules the world. This pure emanation from the divine essence becomes soiled with earthly taint and fettered with an earthly body, whence mortal desires, sorrow and pain.[1]

So far this is only a more rational expression of the Orphic conception of the soul, but the pure Stoic teaching had nothing of the idea of metempsychosis. The necessity of penance and purification after death is, however, recognized. On the death of the body the soul is not yet cleansed of the earthly stain, but must wander for a time in the dense, heavy atmosphere near the earth, the turbulent region of clouds and storms,[2] where it does penance and is purified, after which it soars into the pure region of the sun and finds its home in the ethereal fire whence it came.[3]

This idea of a purgation which the later Stoic thought located in the cloudy atmosphere between the earth and heaven's "pure serene" is borrowed by Vergil, though it is expressed in Orphic terms, and, seemingly, made a part of his scheme of purification in Hades.[4] Lines 735–44 can mean only that all who are sent to the broad spaces of Elysium must pass through a stage of preliminary punishment and purification, not all in equal degree, but each in accordance with his merits. *Quisque suos patimur manes.*

It is the following lines which present the difficult problem:

> Mittimur Elysium et pauci laeta arva tenemus
> donec longa dies, perfecto temporis orbe,

[1] Rohde *Psyche* II, pp. 320, 321; Cicero *Tusc.* i. 42–45; Verg. *Aen.* vi. 724–34.

[2] Cicero *Tusc.* i. 42. [3] Seneca *Consol. ad Marc.* 25.

[4] Do we have here simply an instance of Vergil's eclectic tendency, or was the Stoic teaching in the source from which he learned it already contaminated and confused with earlier mystic ideas?

concretam exemit labem purumque relinquit
aetherium sensum atque aurai simplicis ignem.
Has omnes, ubi mille rotam volvere per annos,
Laetheum ad fluvium deus evocat agmine magno,
scilicet immemores super ut convexa revisant
rursus et incipiant in corpora velle reverti.

Is the Elysium here mentioned merely a poetic substitute for the Stoic ethereal heaven? Is it, in other words, the final goal of the soul, the ultimate paradise, and do the "few" possess the "happy fields" *forever?* This is the general view.[1]

But as the text stands they possess the happy fields only until the long cycle of time completed has washed away the last trace of impurity and left the clear, ethereal essence. It is assumed, therefore, that lines 745–47 have dropped out of their right place and should be written after 742.[2] The sense would then be that after the punishment and purification described in 739–43 have continued through the *longa dies perfecto temporis orbe*, and cleansed the soul of every taint, then finally the few enjoy Elysium.

To this remedy it may be objected that it is too heroic to be used save as a last resort:[3] and, furthermore, it clears up one difficulty only to make another. We may well ask: If only those who have undergone this long purification are in Elysium, how can Anchises be there? But this is a minor inconsistency, of which Vergil might easily have been capable. The serious objection appears in 748–51. It is not the *few* only who possess the happy fields. "All these" (*has omnes*) who are not released from the cycle and are summoned by the god to drink of Lethe and undergo another incarnation are also in Elysium, not in a place distinct from it as Norden holds. He regards the *seclusum nemus in valle reducta et virgulta sonantia silvae* in which these are congregated

[1] Of the editors Wagner, Heyne, Conington, Ribbeck, but not Norden; also of Rohde *Psyche* II, p. 165, n. 2; Dieterich *Nekyia*, p. 155. Cf., however, Maas *op. cit.*, p. 231.

[2] Ribbeck actually gives this order in his text.

[3] Dieterich has an ingenious explanation which aims to do away with the difficulty without disturbing the lines. He would put a period after *tenemus*, 744, marking a distinct pause in the words of Anchises. After *ignem*, 747, he would remove the period, making ll. 745–47 look forward rather than backward. This would be helped out, he thinks, by some dramatic gesture of Anchises. The sense would then be the same as if ll. 745–47 were written after 751. (*Nekyia*, p. 156.) However, this is rather too ingenious. See objections to it in Glover's *Studies in Vergil*, p. 249.

as the purgatory to Elysium proper and the region where the punishments mentioned in 740–42 take place.[1] He cites as a parallel "the kindliest region of the air which they call the meadows" of Plutarch's *De facie in orbe lunae* 943 C. But this is simply the *Vorparadies* of the mystic teaching, not a place of purification through *punishment*. Plutarch combines Stoic and Orphic ideas. The ultimate paradise, according to the passage, is the upper surface of the moon. Between the moon and the earth is a region where the wicked are punished, and another distinct from this where the good are purified.

The only distinction between "the few" of 744 and "all these" of 748 is that the latter are doomed to return to earth after their sojourn of a thousand years. These must drink of the water of Lethe in order that they may lose the vision of Elysian joy and so be willing to return to the upper world. If they were anywhere else than in the paradise of Hades, if they were in a region of purgation through punishment as Norden thinks,

> Quam vellent aethere in alto
> Nunc et pauperiem et duros perferre labores![2]

Does Vergil's Elysium then serve as the eternal home of the chosen few, and at the same time as the temporary abode between incarnations of those who are condemned to revisit the earth? This is incredible, or at any rate without parallel in Greek or Roman thought.

Nor is there any clear parallel in this realm of ideas, so far as I know, for an Elysium in Hades as the final abode of the good.[3] The lower world was at best thought of as an awesome place. With all that poetic fancy could do to paint a subterranean region in cheerful colors, furnish it with light and deck it with flowers and groves, an Elysium in Hades remained nevertheless a place of comparative gloom.[4] That is why Plato put even his *Vorparadies* somewhere in the heavens and his ultimate paradise in the heaven that is above the heavens. The teaching

[1] His edition of *Aeneid* vi, pp. 21 ff.

[2] Said of those in Vergil's limbo, vss. 435, 436.

[3] A possible instance is the χῶρος εὐσεβῶν of the Pseudo-Platonic Axiochus. The "Isles of the Blest" of Plato's *Gorgias* are probably not in the lower world. See Weil, p. 61, and Stewart's *Myths of Plato*, p. 109.

[4] A place where, as in the Orphic lines above quoted, the good have a "milder fate," μαλακώτερον οἶτον, not that of ideal bliss.

of the mysteries, the speculations of philosophers and poets who gave the soul a destiny beyond the grave, and popular fancy[1] among the Greeks as among us, placed the final goal of the spirit in the upper world, generally in the "pure serene" of the starry heaven. All this would suggest at least the probability that Vergil's Elysium is not an ultimate paradise, but a temporary abode of the good in the lower world.

The general sense of the mystic conceptions of which I have tried to give a summary points to an interpretation of the passage which, I think, disposes of its difficulties without tampering with the text or rearranging the lines. It is this: Vergil's Elysium is not the final destiny of the soul but, like the "fair meadow" of the Orphic verses, the Elysium of Pindar, the intermediate heaven of Plato, it is a place where, after the death of the body, the good are sent for purification.[2] The *longa dies perfecto temporis orbe*, 745, is the Orphic cycle, or the period of ten thousand years of the *Phaedrus* myth which must elapse before the average soul can rise from its fall and be restored to its divine estate.

Those designated in the words

> has omnes, ubi mille rotam volvere per annos,
> Lethaeum ad fluvium deus evocat agmine magno

are the majority of those who come to Elysium. These, the average good, are subject to the general law of birth and rebirth. After each life of the body they come to Elysium, where they remain a thousand years before they return to earth. The *rota* here mentioned is evidently the Orphic wheel of life.

How then about the "few" who remain in Elysium throughout the cycle? We have seen that in the mystic teaching a chosen few are in a degree made exempt from the long and wearisome cycle. They are released from the necessity of submitting themselves to the full number of incarnations. This idea Vergil treats freely, and releases the few who have merited it from the necessity of any further life in the body. While the others through the long cycle descend to Elysium and ascend to earth again and again in each recurring period of a thousand years

[1] Cf. a number of epitaphs cited by Rohde II, pp. 384 ff.

[2] The purification through punishment, of ll. 739–44, is a preparation for Elysium. However, *penitusque necesse est | Multa diu concreta modis inolescere miris*, and somewhat of the *concreta labes* remains to be purged away in Elysium.

until they are purified and released from the wheel, the chosen few remain in Elysium until the cycle is completed and the last vestige of earthly taint is purged away.

> donec longa dies, perfecto temporis orbe,
> concretam exemit labem purumque relinquit
> aetherium sensum atque aurai simplicis ignem.

When at length the purgation is accomplished, what becomes of the pure ethereal essence? The inevitable answer is: The pure spirit returns to its pure source. Like to like, is the law of mystic thought. The earthly taint is left behind in its earthly and under-earthly life, and the spirit goes back to the god who gave it and the place whence it came.[1]

> ὅθεν δ' ἕκαστον εἰς τὸ σῶμ' ἀφίκετο
> ἐνταῦθ' ἀπελθεῖν, πνεῦμα μὲν πρὸς αἰθέρα
> τὸ σῶμα δ' εἰς γῆν.

If it be objected that Vergil does not say this in so many words, it may be said in reply that the aim of the sixth book is not primarily to give a notion of the ultimate destiny of the soul, but to furnish a dramatic setting for Anchises' prophecy of the greatness and glory of Rome.

[1] Eurip. *Suppl.* 532–35; Epicharmus, fr. 35.

THE FISHES OF THE ROCKY MOUNTAIN REGION

By T. D. A. Cockerell

For class use, and in connection with my studies of the Rocky Mountain fauna, I have found it necessary to prepare an abstract of our knowledge concerning the fishes of the Rocky Mountain region. The area covered is roughly Montana, Wyoming, Colorado and New Mexico, but the boundaries have been somewhat extended here and there to include certain species. The fossil species are given, although it is anticipated that fresh discoveries will greatly enlarge our knowledge of these in the near future. A good series which the University Expedition of 1907 obtained in the Miocene shales of Florissant is now being studied by Dr. Eastman.

The information given in this paper is compiled from the literature, with the exception of the results of a study of the fishes of Boulder County, based on material in the University of Colorado Museum, mostly collected by Mr. Chancey Juday. By far the greater part is derived from the monumental work of Jordan and Evermann on the *Fishes of North and Middle America* (*Bull. 47, U. S. Nat. Museum*), which is the main source of information for all students of American ichthyology.[1] *American Food and Game Fishes*, by the same authors, but of later date (1902), has also been found exceedingly useful. The basis of our knowledge of Boulder County fishes is the paper by Professor Chancey Juday in *University of Colorado Studies*, Vol. II, p. 113, and *Bull. U. S. Bureau of Fishes*, March 17, 1905. In these papers, unfortunately, the diagnostic characters of the fishes (excepting the new *Leuciscus*) are not given; these I have endeavored to supply. For records of the fossil species, I am primarily indebted to the invaluable catalogue of the *Fossil Vertebrata of North America*, by O. P. Hay (*Bull. 179, U. S. Geol. Survey,* 1901).

I am exceedingly indebted to Dr. B. W. Evermann, who has kindly

[1] The figures illustrating the present paper are derived from this work, with the kind permission of the authorities of the National Museum.

examined the manuscript, and has made a critical examination of a *Notropis* which I had failed to identify.

In the study of geographical distribution, especially as related to past conditions, the value of the evidence afforded by fresh-water fishes can hardly be exaggerated. Thus the following contrast between the genera of the Gila and Rio Grande basins should make those hesitate who believe in the recent depression of the continent in the region of southern New Mexico and Arizona.

CYPRINIDAE

GILA R. BASIN	BOTH	RIO GRANDE BASIN
Gila	**Leuciscus* (also one in Yaqui R. basin, the species of all three basins very close.)	**Campostoma* (also one in Yaqui R. basin)
Tiaroga		**Hybognathus*
Agosia		**Pimephales*
Meda		*Cochlognathus*
		Cliola
		**Notropis*
		**Phenacobius*
		**Rhinichthys* (but also in Great Basin)
		**Hybopsis*

* Boulder County, Colo. (Platte R. Basin).

The case of *Leuciscus*, and the rather similar one of *Rhinichthys*, come under the head of "exceptions which prove the rule;" for the close resemblance (in *Rhinichthys* even identity) of species on the Atlantic and Pacific slopes, taken with the great general diversity, simply shows that these forms must have been transported in some way from one basin to another *since* the separation of the drainage areas. That they are ultra-conservative forms, preserving their characters while all around them has changed in the course of ages, seems scarcely possible.[1]

The general similarity between the fishes of the Rio Grande and Platte basins is as striking as the diversity in the other case.

It is noteworthy that the trout (*Salmo*), which inhabit the waters of

[1] The strong and numerous fish fauna of the Mississippi valley may be thought of as spreading westward, to be checked by the Rocky Mountain chain. How recent this spread may be, and how far it has resulted in the extermination on the Atlantic slope of the mountains of specially western types, remains uncertain; adequate paleontological evidence is wanting. It is proper to remember, however, that characteristic Mississippi valley types of Mollusca occur in the Cretaceous of the Rocky Mountain region.

the high mountains, show closely allied species on the Atlantic and Pacific slopes of the Rocky Mountains.

In the tables and descriptions, D=dorsal fin, A=anal fin; the numbers following these indicate the numbers of rays in the fins, thus D8 means eight rays in the dorsal fin. A roman numeral, as I, II, etc., refers to spines.

The fin-formulae are written as for instance 5–64–7, which "means that there are five rows of scales between the base of the dorsal fin and the lateral line (the scale in the lateral line excluded), 64 oblique transverse series crossing the lateral line, and 7 horizontal scales between the lateral line and the base of the anal or the vent" (Jordan and Evermann).

The teeth-formulae in the Cyprinidae refer to the teeth on the pharyngeal bones. "In most cases a principal row of 4 or 5 larger teeth will be found, in front of which is a set of one or two smaller ones. The two sides are usually, but not always, symmetrical. Thus, 'teeth 2, 4–5, 1' indicates two rows of teeth on each side, on the one side 4 in the principal row and 2 in the lesser; on the other side 5 in the main row 1 in the other" (Jordan and Evermann).

The Orders are given as in Jordan and Evermann; but they seem nearly to correspond with superfamilies in Insecta.

Class **PISCES** (The Fishes)

Subclass **SELACHII** (The Sharks and Rays)

Order **PLEURACANTHIDES**

The Cladodontidæ are represented by *Cladodus girtyi* Hay, in the Coal Measures of Colorado.

Order **ASTEROSPONDYLI** (The Typical Sharks)

Family **Cochliodontidæ**

Orthopleurodus novomexicanus St. John & Worth., and *Poecilodus springeri* St. John & Worth., were described in 1883 from the Subcarboniferous of New Mexico.

Deltodus mercurii Newb., is from the Coal Measures of New Mexico.

Family **Heterodontidæ** (The Bullhead Sharks)

Hybodus polyprion Agassiz, is reported from the Jurassic of Wyoming; it is found also in England.

Family **Galeidæ**

Galeocerdo hartwelli Cope, is from the Niobrara Cretaceous of Colorado.

FAMILY **Lamnidæ** (The Mackerel Sharks)

Corax falcatus Agassiz, is recorded from the Cretaceous of Colorado, and also occurs in Europe. I have collected teeth of this group near Las Vegas, New Mexico, and Colorado Springs, Colorado, but they were not determined.

ORDER **BATOIDEI** (The Rays)

FAMILY **Ptychodontidæ**

Ptychodus whipplei Marcou, occurs in the Niobrara Cretaceous of Colorado and New Mexico. I have collected the characteristic teeth near Las Vegas, N. M.

FAMILY **Dasyatidæ** (The Sting Rays)

Dasyatis radians Marsh. (*Xiphotrygon acutidens* Cope), is found in the Green River beds of Wyoming.

SUBCLASS **HOLOCEPHALI** (The Chimæras)

In this group the skeleton is cartilaginous, and the skin is without scales.

ORDER **CHIMÆRIOIDEI**

FAMILY **Chimæridæ**

Some fossil genera referred here are of very doubtful affinities. *Dictyorhabdus priscus* Walcott, is from the Silurian or Ordovician of Colorado. *Myledaphus bipartitus* Cope, and *Hedronchus sternbergi* Cope, are from the Fort Union Cretaceous of Montana. With regard to the *Myledaphus*, Hatcher remarks that it was founded on isolated teeth, so uncharacteristic as to be of little value for determining genera or species. Such teeth, however, are abundant in the Judith River beds and the Laramie. *Hedronchus* was based on part of a tooth. The modern Chimeridæ are found in the seas of cold regions (Jordan and Evermann).

SUBCLASS **TELEOSTOMI** (The True Fishes)

ORDER **SIRENOIDEI**

FAMILY **Ceratodontidæ**

The genus *Ceratodus* Agassiz, is represented by five fossil species. From the Jurassic are *C. americanus* Knight (Wyoming), *C. guentheri* Marsh (Colorado), and *C. robustus*, Knight (Wyoming). From the Cretaceous, *C. eruciferus* Cope and *C. hieroglyphus* Cope; according to Hatcher these latter occur in the Judith River beds of Montana.

ORDER **RHIPIDISTIA**

FAMILY **Holoptychiidæ**

Eriptychius americanus Walcott, 1892, is from the Lower Silurian or Ordovician of Colorado.

ORDER **SELACHOSTOMI**

FAMILY **Polyodontidæ** (The Paddle Fishes)

Crossopholis magnicaudatus Cope, comes from the Eocene of Wyoming.

ORDER **CHONDROSTEI** (The Sturgeons)[1]

FAMILY **Acipenseridæ**

Length up to five feet; snout broad and depressed, subspatulate (Missouri R. at Fort Benton, Mont., *Henshall*) . . . . . *Scaphirhynchus platorynchus* (Raf.) (Shovel-nose Sturgeon).

[1] *Diphyodus longirostris* Lambe, is based on fragmentary jaws of uncertain affinities, from the Cretaceous of Canada, and also occurring in Montana and Wyoming.

This is the only North American species; others occur in Central Asia.

Dermal structures referred to *Acipenser albertensis* Lambe are found in the Judith R. and Laramie beds of Wyoming, etc.

Order **RHOMBOGANOIDEA** (The Gar Pikes)

Numerous species assigned to *Lepidosteus* have been described from the Cretaceous, and Wasatch and Bridger Eocene. *L. aganus* (Cope) and *L. integer* (Cope) are from New Mexico. *L. atrox* Leidy, *L. cycliferus* (Cope), *L. glaber* Marsh, *L. notabilis* Leidy, *L. occidentalis* Leidy,[1] *L. simplex* Leidy and *L. whitneyi* Marsh are from Wyoming. The living *L. osseus* (L.) occurs in the Rio Grande. Other species live in different parts of North and Central America and one in China.

Order **CYCLOGANOIDEA** (The Bowfins)

The single living species (*Amia calva* L.) inhabits the eastern states, and comes as far west as Texas. Two (*A. dictyocephala* Cope and *A. scutata* Cope) are from the Miocene of Colorado. Six (*A. depressa* Marsh, *A. elegans* Leidy, *A. gracilis* Leidy, *A. media* Leidy, *A. newberriana* Marsh, and *A. uintaensis* Leidy) are from the Bridger Eocene of Wyoming.

Order **NEMATOGNATHI** (The Catfishes)

Family **Siluridæ**

Rhineastes Cope, is a genus containing one species (*R. pectinatus* Cope) in the Florissant Miocene and five (*R. arcuatus* Cope, *R. calvus* Cope, *R. peltatus* Cope, *R. radulus* Cope, and *R. smithii* Cope) in the Bridger Eocene of Wyoming.

The living species of the Rocky Mountains are as follows:

Adipose fin keel-like, adnate to the back; length up to over a foot; color yellowish brown; fins yellow-edged; anal rays about 16 (Missouri R. in Montana; Wyoming; Platte R.) *Noturus flavus* Raf. (Stone Cat).

Adipose fin with its posterior margin free . . . . . 1.

1. Anal fin very long, its rays 32 to 35 (Rio Grande) *Ictalurus furcatus* (Le Sueur).
   Anal fin with rays 30 or less . . . . . 2.
2. Anal rays 23. . . . . (Pecos R.) . . . . *Ameiurus lupus* (Girard).
   Anal rays 25 to 30; light olivaceous above, the sides pale or silvery, and nearly always with small dark spots (Missouri R., Milk R., and Yellowstone R. in Montana, *Hen. shall;* Platte R.) . . . . . *Ictalurus punctatus* (Raf.) (Channel Catfish).

Six other forms of *Ameiurus* occur in Texas. *Leptops olivaris* (Raf.), the mud cat, occurs from the Ohio River to the Mexican State of Chihuahua.

Order **PLECTOSPONDYLI** (Carplike Fishes)

Teeth well developed in both jaws (in our species) . . . . . *Characinidæ.*

Jaws toothless . . . . . 1.

1. Pharyngeal teeth numerous, pectinate; dorsal fin with 10 or more rays *Catostomidæ.*
   Pharyngeal teeth few; dorsal fin (in ours) short with less than 10 rays . *Cyprinidæ.*

[1] *L. occidentalis* and *haydeni*, of the Judith River beds, were based merely on scales, and are believed to belong to the same species. The supposed differences are: Scale not over 8 mm. long, the enameled surface smooth and shining, *occidentalis* (Leidy); Scale 10 mm. long, the enameled surface with "parallel square lines," *haydeni* (Leidy).

FAMILY **Catostomidæ** (The Suckers)

Amyzon Cope, is represented in the Miocene of Florissant (*A. commune* Cope, *A. jusiforme* Cope, *A. mentale* Cope, *A. pandatum* Cope).

The living Rocky Mountain species are:

Dorsal fin elongate, with 26 or 27 rays (Boulder County, *Juday;* Milk R. and Poplar R. in Montana, *Henshall;* Rio Grande) . . . *Carpiodes velifer* (Raf.) (Quillback).

Dorsal fin with not over 18 rays . . . . . 1.

1. With a sharp-edged hump on the back, not extending forward to the nape; D 12, A 7; scales 16–81–13. (Known from a single specimen, 7 inches long, from the Uncompahgre River at Delta, Colo.) *Xyrauchen uncompahgre* Jordan and Evermann (*X. cypho* Lock.), from the basin of the Colorado and Gila Rivers, has a higher hump, which usually begins at the nape.)
   Normally formed, not humped . . . . . 2.
2. Scales in lateral line less than 50 . . . . . 3.
   Scales in lateral line over 60 . . . . . 4.

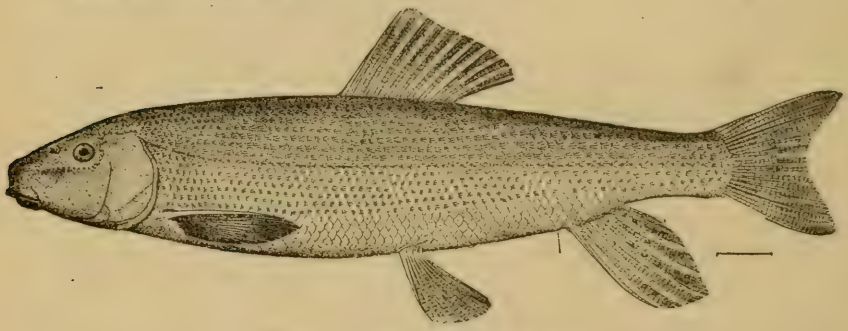

FIG. 1.—*Catostomus commersonii.*

3. Dorsal rays usually 12; dusky above, with usually a black blotch behind the dorsal fin; each scale along the sides with a small, more or less distinct blackish spot at its base, these spots forming interrupted longitudinal lines along the rows of scales; size up to 18 inches long. (Yellowstone R.)
   Minytrema melanops (Raf.) (Spotted Sucker).

Dorsal rays usually 13; olivaceous, sides silvery, lower fins in adult red or orange (Poplar R., Mont., *Henshall*) . . . . . *Moxostoma aureolum* (Le Sueur).

4. Scales in lateral line less than 80; fontanelle between parietal bones present, widely open . . . . . 5.
   Scales in lateral line 80 or more . . . . . 7.
5. Dorsal fin long, of 15 rays; head large (Swan Lake and Post Creek, Montana, *Henshall*) . . . . . *Catostomus macrocheilus* Girard.
   Dorsal fin with 11 to 13 rays . . . . . 6.
6. Upper lip narrow, with usually but 3 to 5 rows of papillæ, but in var. *sucklii* (Girard) with 4 to 6; species of Atlantic slope (Boulder Creek, common; Milk R. and Poplar R., Montana; Twin Lakes, Colo.; Arkansas R. at Pueblo, Colo.)
   Catostomus commersonii (Lacép.).

The western forms are all or mainly var. *sucklii*, which approaches *C. ardens*. (Common Sucker.)

Upper lip broader, 4 to 6 rows of papillæ; species of Great Basin (Heart Lake, Yellowstone Park) . . . . . *Catostomus ardens* (Jordan and Gilbert).

7. Species of the Rio Grande basin, Colorado to Chihuahua; scales 80 *Pantosteus plebeius* (Baird and Girard).

Species of Wyoming, Montana and Northern Colorado, scales 90 or more 8.

8. Head comparatively large, 4 in length of body; scales 16–90 to 110–14; upper lip with 5 to 8 series of tubercles; lower lip incised to base; dorsal fin with usually 11 rays (Boulder Creek, abundant; Platte River; Montana). *Catostomus griseus* (Girard).

(Var. *lactarius* (Girard) appears to have larger scales, 88 to 90; var. *retropinnis* (Jordan) has fuller lips and a more backward dorsal. (Both these supposed varieties are from Milk River, Montana.)

Head relatively smaller . . . . . 9.

9. Species of Colorado River Basin . . . . . 10.

Species of Missouri and Columbia R. Basins . . . . . 11.

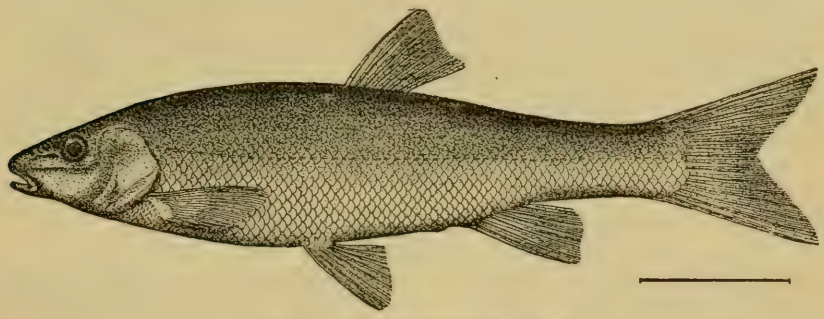

FIG. 2.—*Campostoma anomalum.*

10. Size up to 2 feet; sides and fins largely orange; dorsal rays 11 to 13; scales 17–98 to 105–17 . . . . . *Catostomus latipinnis* (Baird and Girard).

(Henshall gives *C. discobolus* Cope, from Montana and Wyoming, as distinct.)

Size up to one foot; dorsal rays 10; scales 16–96 to 105–14 (W. Colorado; Wyoming) . . . . . *Pantosteus delphinus* (Cope).

(*P. virescens* Cope, reported in error from Pueblo, Colo., is the same.)

11. Length to 2½ feet; head quite long and slender; scales 95 to 114 in lateral line (Montana) . . . . . *Catostomus catostomus* (Forst.) (Long-nosed sucker).

Length to about one foot; head short, conic; scales 90 to 100 in lateral line (Montana) *Pantosteus jordani* (Evermann).

Another genus of suckers, *Chamistes*, is confined to the Great Basin, with species in Utah, Nevada and Oregon. It has the mouth very large, and terminal instead of inferior as it is in *Catostomus*, and other characters.

FAMILY **Cyprinidæ** (The Carp Family)

The following table separates the genera found in Boulder County, Colorado.

Air-bladder surrounded by many convolutions of the very long alimentary canal; peritoneum black; herbivorous. Sexual differences very great, the males covered with large tubercles in the spring . . . . . *Campostoma.*

Air-bladder above the alimentary canal, as is normal . . . . . 1.

1. Intestinal canal elongate, usually over twice length of body; peritoneum usually black . . . . . 2.
   Intestinal canal short, less than twice length of body . . . . . 4.
2. Dorsal fin inserted posteriorly; scales minute . . . . . *Chrosomus.*
   Dorsal fin nearly median . . . . . 3.
3. First (rudimentary) ray of dorsal slender, firmly attached to the first developed ray as is normal . . . . . *Hybognathus.*

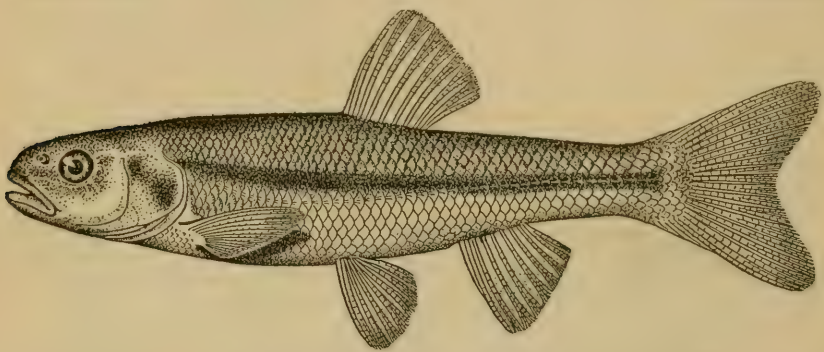

FIG. 3.—*Leuciscus evermanni*, reproduced from the original illustration with permission of the Bureau of Fisheries.

   First (rudimentary) ray of dorsal somewhat enlarged and blunt, connected by membrane with first developed ray . . . . . *Pimephales.*
4. Teeth in the main row 5–5 or 4–5 . . . . . 5.
   Teeth in the main row 4–4, the lesser row often absent . . . . . 6.
5. Maxillary with a minute barbel . . . . . *Semotilus.*
   Maxillary without barbel; teeth strongly hooked . . . . . *Leuciscus.*
6. Maxillary without barbels . . . . . 7.
   Maxillary with a small barbel . . . . . 8.
7. Lower jaw with the lip thin or obsolete; scales large. . . . . *Notropis.*
   Lower jaw with the lip developed as a fleshy lobe on each side . . . *Phenacobius.*
8. Premaxillaries not protractile; scales small. . . . . *Rhinichthys.*
   Premaxillaries protractile . . . . . 9.
9. Teeth 4–4, or 1, 4–4, 1, or 0, the lesser row with never more than one *Hybopsis.*
   Teeth usually 2, 4–4, 2, the lesser row rarely with less than two . . *Couesius.*

The following table for the species is based on the fins and scales:

   Dorsal with spine; DI. 7, A 7; scales 7–43 to 47–6 . . . *Pimephales promelas.*
   Dorsal without spine . . . . . 1.

1. Scales in lateral line over 80 (scales 16–85–10), D 7, A 8 . . . *Chrosomus erythrogaster.*
   Scales in lateral line less than 75 . . . . . 4.
4. Scales above lateral line 11 or 12[1] . . . . . 5.
   Scales above lateral line 9 or less . . . . . 6.
5. D 8, A 7. Scales 11 or 12–63 to 70–9 to 12 . . . *Rhinichthys cataractæ dulcis.*
   D 8, A 8, Scales 12–64 to 72–8 . . . . . *Couesius dissimilis.*
6. Scales in lateral line over 40 . . . . . 7.
   Scales in lateral line less than 40 . . . . . 12.
7. Scales less than 5 below lateral line[1] . . . . . 8.
   Scales 5 or more below lateral line . . . . . 9.
8. D 8, A 9. Scales 6–41–3 . . . . . *Notropis cornutus.*
   D 8, A 7. Scales 6–41–4 . . . . . *Hybopsis kentuckiensis.*
9. D 8, A 7 . . . . . 10.
   Otherwise . . . . . 11.

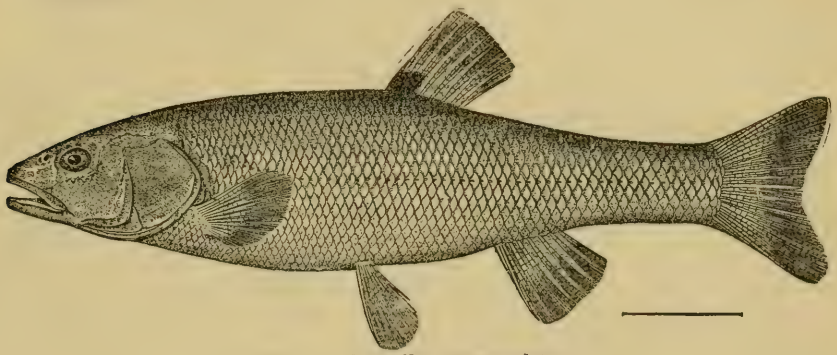

FIG. 4.—*Semotilus atromaculatus.*

10. Scales 7–53–8 . . . . . *Campostoma anomalum.*
    Scales 6–43 to 45–5 . . . . . *Phenacobius scopifer.*
11. D 7, A 8. Scales 9–50 to 60–6 . . . . . *Semotilus atromaculatus.*
    D 8, A 8. Scales 9–47–5 . . . . . *Leuciscus evermanni.*
12. Scales 31 to 33. D 7, A 7 . . . . . *Notropis scylla.*
    Scales 35 or more . . . . . 13.
13. Scales below lateral line 2 (scales 6–35–2); D 7 or 8, A 8 . . *Notropis lutrensis*
    Scales below lateral line 4 . . . . . 14.
14. D 7, A 8; Scales 6–36–4 . . . . . *Notropis piptolepis.*
    D 8, A 7 . . . . . 15.
15. Scales 5–38–4 . . . . . *Hybognathus nuchalis.*
    Scales 5–35–4 . . . . . *Notropis cayuga.*

The above tables are almost entirely derived from the literature. The following one is made from the specimens without reference to the literature:

Two very distinct dark bands on each side; snout blunt; mouth normal; no barbel; scales small, imbedded in the skin; length less than 65 mm.

Chrosomus erythrogaster.

[1] As usually counted; *cf.* preface,

Only one distinct lateral dark band, or none . . . . . 1.

1. Mouth inferior, with rounded corners and thickened lips, sucker-like . 2.
   Mouth ordinary . . . . . 4.
2. Anterior end of dorsal conspicuously before anterior end of ventrals; scales large; snout in lateral view truncate; lips papillose; no barbel . . *Phenacobius scopifer.*
   Anterior end of dorsal level with or posterior to anterior end of ventrals 3.
3. Dorsal without a band; scales small; size rather small; often a small barbel. *Rhinichthys cataractæ dulcis.*
   Dorsal with a black or gray band; scales large; size larger, to over 120 mm.; sides mottled with gray . . . . . *Compostoma anomalum.*
   [Length of ventrals hardly greater than their distance from tips of pectorals *Campostoma anomalum.*
   Length of ventrals much greater than their distance from tips of pectorals *Phenacobius* and *Rhinichthys.*]

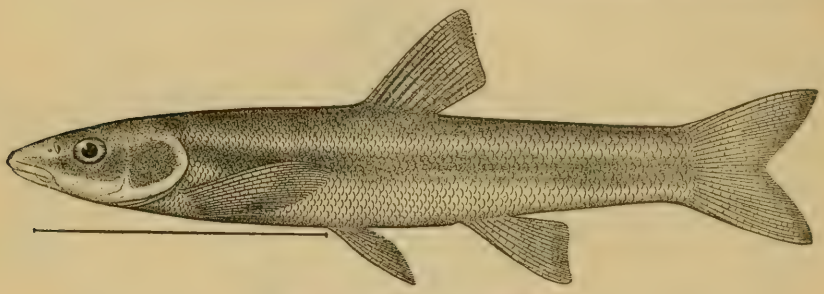

FIG. 5—*Rhinichthys dulcis.*

4. Tips of ventrals reaching base of anal . . . . . 5.
   Tips of ventrals not (usually not nearly) reaching base of anal . . . 7.
5. Body deep . . . . . 6.
   Body not so deep; dorsal with no black spot in front. . . . *Notropis cayuga.*
6. A black spot at base of dorsal; lateral line very incomplete; color above very dark; length about 70 mm. depth about 16 mm. . . . . *Pimephales promelas.*
   No black spot on dorsal . . . . . *Notropis lutrensis.*
   [*Notropis piptolepis* varies, so that tips of ventrals may reach base of anal, or miss it by a short interval.]
7. Scales large, 10 to 12 (8 in *N. scylla*) in oblique line from dorsal to ventrals . . . . . 8.
   Scales moderate, 13 to 14 in oblique line . . . . . *Leuciscus evermanni.*
   Scales small, 15 or more in oblique line . . . . . 10.
8. Eye smaller and snout longer, so that distance from eye to tip of snout is nearly twice diameter of eye . . . . . *Hybopsis kentuckiensis.*
   Eye larger and snout shorter, so that distance from eye to tip of snout is not nearly twice diameter of eye, or is little more than once diameter . . . . 9.
9. In lateral profile, height of eye about equal to, or a trifle less than, distance from eye to nearest point on lower margin of head . . . . . *Notropis cornutus.*

In lateral profile, height of eye distinctly more than distance from eye to nearest point on lower margin of head . . . . . *Notropis scylla* [also *N. piptolepis*]. [Here also see *Hybognathus nuchalis*, in which the tips of ventrals are only about 1½ mm. short of base of anal. *Hybopsis kentuckiensis* has a very distinct dark spot at base of caudal; *Notropis cornutus* has a dark lateral band, but no separated spot. The three species of *Notropis* all have a dark dorsal band. *N. zonatus*, var., which also comes in here, has a pale orange dorsal band.]

10. A black spot at base of dorsal fin; middle of head above not tuberculate; barbels absent, or small barbels, away from corner of mouth; corner of mouth about level with front of eye; body not so deep as in *Couesius;* pigmentation of sides consisting of minute gray rings or diffuse spots; scales with about 16 radiating lines, but these hidden by the thick skin . . . . . *Semotilus atromaculatus.*

No black spot at base of dorsal; middle of head above tuberculate; barbels small but evident, at corner of mouth; corners of mouth strongly anterior to eye; pigmentation of sides consisting of small black dots; scales with 10 or 11 radiating lines, these visible through the thin skin . . . . . *Couesius dissimilis.*

The following table of *Notropis* species is based on the information given by Jordan and Evermann:

Teeth 2, 4–4, 2. D 8, A 9. Length 7 to 8 inches . . . . . *N. cornutus.*

Teeth 4–4 or 1, 4–4, 1. Length 3 inches or less . . . . . 1.

1. Scales not very closely imbricated, not noticeably deeper than long; dorsal inserted nearly over the ventrals; anal short, its rays 7 or 8; no black spot on dorsal fin . . . . . 2.

Scales deeper than long, more or less closely imbricated on sides of body; scales moderate, 33–38 in lateral line; D 7 or 8, A 8; teeth 4–4; male in life brilliant steel blue, the belly orange-red, anal and caudal blood red, a conspicuous violet crescent behind the shoulders, followed by a crimson crescent; female plain greenish. Length 2¾ inches . . . . . *N. lutrensis.*

2. Teeth 2-rowed (1, 4–4, 1). Small slender species; D 7, A 8; olivaceous, silvery below; a broad silvery lateral band, with dark specks; sides of head with black specks; a dark dorsal band. Length 3 inches . . . . . *N. piptolepis.*

Teeth 1-rowed (4–4) . . . . . 3.

3. Lateral line wanting on some scales; eye large; scales above dark-edged, the outlines very sharply defined; a black stripe through snout and eye; a dusky lateral shade and a small caudal spot. Length 2½ inches . . . . . *N. cayuga.*

Lateral line complete; D 7, A 7. Color pale, back greenish, side with a silvery band, no spots on fins; a dusky shade on each side of dorsal and before it; some dark spots on snout. Length 2¾ inches . . . . . *N. scylla.*

The following is based on specimens, without reference to the literature:

Body deep, its depth nearly or quite equal to distance between base of anal and hind edge of insertion of pectorals; base of dorsal not before base of ventrals. *N. lutrensis.*

Body not so deep, its depth not nearly equal to distance between base of anal and hind edge of insertion of pectorals . . . . . 1.

1. Base of dorsal distinctly (1 or 2 scale rows) before base of ventrals; length over 80 mm. *Hybognathus nuchalis.*

Base of dorsal level with or posterior to base of ventrals . . . . 2.

2. A very distinct black spot at base of caudal; size rather large, 75 mm. *N. scylla.*
(Still larger, but with no spot at base of caudal . . . . . *N. cornutus.*)
No distinct spot at base of caudal; our specimens smaller, 70 mm. or less 3.

3. A very distinct black band from snout to eye, and continuing behind eye *N. cayuga.*
No such black band, or at most vestiges of it, behind eye only . . . 4.

4. A strong black dorsal band, on a grayish-yellow ground;[1] the scales dusky-margined by copious dots; sides more or less silvery; broad, breadth 9 or 10 mm. in fish about 70 mm. long . . . . . *N. piptolepis* (see here also *cornutus* when young).
A pale orange dorsal band on a bright straw-yellow ground,[1] the scales minutely black-dotted, but not appearing dusky-margined; sides strongly silvery; lateral line complete; a grayish lateral stripe; dorsal and caudal fins yellowish; dorsal black speckled; D 8, A 9 (not counting rudimentary anterior ray); a crest above each nostril; chin black-speckled; scales 8 or 9–38–5, 12 before dorsal in lateral line; form narrow, breadth 6 mm. in fish about 65 mm. long. (Boulder Creek, Boulder, Nov. 1907.) . . . . . *Notropis zonatus* (Agassiz), var.[2]

The recorded Rocky Mountain Cyprinidæ are as follows:

Campostoma anomalum Raf. Colo., Wyo.

Chrosomus erythrogaster Raf. Colo.

Hybognathus nuchalis Agass. Colo., Mont.

H. argyritis Girard. Milk R. Mouth wider than in *nuchalis;* may intergrade.

H. (*Dionda*) *serena* Girard. Pecos R. D 8, A 8. Scales 5–32 to 34–3.

H. (*Dionda*) *episcopa* Girard. Pecos R. D 8, A 8. Scales 9–37 to 41–4.
The name is in punning allusion to Capt. Pope, its discoverer.

H. (*Dionda*) *nubila* Forbes. Wyo. D 8, A 9. A dark lateral band.

H. (*Dionda*) *amara* Girard. Rio Grande (doubtful species). D 8, A 7. No dark lateral band.

Pimephales promelas Raf. Colo., Mont., Rio Grande, Yellowstone R.

P. promelas maculosus Girard. Arkansas R. at Pueblo. Lateral line better developed, the pores wanting on less than half of the scales.

P. promelas confertus Girard. Pecos R. drainage in Texas, etc. Lateral line complete, and male differently colored.

Mylocheilus caurinus Richardson. Flathead Lake. A species of the northwest Pacific region, just reaching Montana. Devours eggs of salmon.

Semotilus atromaculatus Mitchill. Colo., Wyo.

Ptychocheilus oregonensis Richardson. Missoula, Mont. Species of Pacific slope.

Ptychocheilus lucius Girard. Delta, Colo. Species of Colorado Basin. The largest of American Cyprinidæ, reaching a weight of 80 lbs. Body slender, elongate, with long, slender depressed head. D 9, A 9.

[1] In alcohol.

[2] This fish was sent to Dr. Evermann, who kindly reports that it is very close to *zonatus*, and probably that species, although it differs slightly in some of its characters. *N. zonatus* is a species of mountain streams in the Ozark region of Missouri and Arkansas, and the discovery of a very closely allied or identical fish in Colorado is of much interest. Typical *zonatus* is said to have scales 6–42–4. Dr. Evermann has added several characters to the diagnosis of our fish. He finds: head 4; eye about 3¾; teeth 2, 4–4, 2; scales 8–43–4, 24 before the dorsal. In my count, I made out fewer scales in the lateral line, but I counted only the pore-bearing ones.

Gila robusta Baird and Girard. Delta, Colo.; Zuni R. Species of Colorado and Gila Basins. Length 16 inches.

Gila elegans Baird and Girard. Gila R. and Zuni R. Length 12 inches.

(*G. nacrea* Cope, from Fort Bridger, Wyo., is *G. robusta* or young *G. elegans.*)

Leuciscus evermanni Juday. Only known from three examples obtained by Professor Juday in Boulder Creek. One of these is in the University of Colorado Museum.

L. lineatus Girard. Wyo. Species of Great Basin and Snake R. Basin. D 9, A 8. Scales in lateral line 53 to 63.

L. nigrescens Girard. San Luis Park; Sangre de Cristo Pass, Colo.; Las Vegas and near Ft. Wingate, N. M. Species of Rio Grande Basin. D 8, A 8. Scales in lateral line 60 to 67.

L. aliciæ Jouy. Evanston, Wyo. Species of Great Basin of Utah. D 8, A 8. Scales in lateral line 80.

L. hydrophlox Cope. Heart Lake, Wyo. Species of Great Basin. D 9, A 10 to 13. Scales 12–58–5. Length 3 to 5 inches.

L. balteatus Richardson. Silver Bow, Mont. Species of Columbia Basin. D 10, A 11 to 22, usually 16. Scales 13–55 to 63–6.

Notropis[1] (*Chriope*) *cayuga* Meek. Colo.

N. (*Alburnops*) *scylla* Cope., Colo., Mont. The type locality is Red Cloud Creek, a tributary of the Platte R.

N. (*Hudsonius*) *gilberti* Jordan and Meek. Platte R. Very close to *piptolepis*, but D 8, A 9; scales 5–35–4; 17 scales before dorsal; light olive, sides with dusky streaks and dark specks.

N. (*Hudsonius*) *piptolepis* Cope. Boulder County; N. Platte R.

N. (*Hudsonius*) *simus* Cope. Rio Grande at San Ildefonso, N. M. D 8, A 9. Scales 8–35–4, 22 series in front of dorsal. Robust, entirely silvery.

N. (*Moniana*) *lutrensis* Baird and Girard. Boulder Co., Colo.; Rio Grande at San Ildefonso, N. M.

N. (*Moniana*) *proserpina* Girard. Rio Grande Region, New Mexico. D 7, A 7. Scales 6–35–3, 14 before dorsal. Brownish above, paler below, but no silvery lateral band; a metallic band of dark points from upper edge of preopercle to upper edge of caudal. Length 2 inches.

N. (*Cyprinella*) *macrostomus* Girard. Roswell, New Mexico. D 8, A 9. Scales in lateral line 36. Brownish above, cheeks and sides bright silvery.

N. (*Luxilus*) *cornutus* Mitchill. Colo.

N. (*Orcella*) *orca* Woolman. Rio Grande at El Paso, Texas. D 7, A 8. Scales 8–42–4. Body plump, top of head unusually high and transversely rounded.

N. atherinoides Raf. Mont. D 8, A 11. Scales 5–38–3. Translucent green above, sides bright silvery. Length 4 to 6 inches.

N. dilectus Girard. Rio Grande at San Ildefonso, N. M. D 8, A 11. Scales 7–38–3. Colors very pale; silvery, snout and bases of fins rosy; a row of black dots above base of anal.

Phenacobius scopifer Cope. Boulder Co., Colo.; Rio Grande.

[1] JORDAN and EVERMANN remark that no *Notropis* is found in Utah. No species is recorded from the Pacific slope in Colorado.

Rhinichthys cataractæ dulcis Girard. Boulder Co., Colo., abundant in Boulder Creek; Las Vegas, N. M.; tributaries of Rio Grande; eastern Wyo. and Mont., also in the Great Basin.

Agosia yarrowi Jordan and Evermann. Colorado R. Basin. Gunnison R. at Gunnison. Genus scarcely different from *Rhinichthys*. D 7, A 7. Scales small, about 16–78–13. Barbel small but distinct. Sides with two ill-defined dark lateral bands.

Hybopsis (*Erimystax*) *æstivalis* Girard. Rio Grande at San Ildefonso, N. M.

Hybopsis (*Erimystax*) *gelidus* Girard. Wyo., Mont.

Hybopsis (*Erimystax*) *montanus* Meek. Upper Missouri, Mont.

Hybopsis storerianus Kirtland. Eastern Wyo.

H. (*Nocomis*) *kentuckiensis* Raf. Colo., Wyo.

The following table is from that of Jordan and Evermann:

Species of large size, not silvery, the mouth larger, nearly terminal *H. kentuckiensis.*
Species of moderate or small size except *storerianus*, the mouth inferior, horizontal; preorbital broad, silvery . . . . . 1.

1. Large up to 10 inches; sides bright silvery . . . . . *H. storerianus.*
   Small, less than 3 inches . . . . . 2.
2. Back and sides pale, not dusted with dark dots . . . . . *H. montanus.*
   Back and sides sprinkled with dark dots . . . . . 3.
3. Lower lobe of caudal pale; snout moderate . . . . . *H. æstivalis.*
   Lower lobe of caudal black in life; snout very long . . . . . *H. gelidus.*

Couesius squamilentus Cope. Henry Fork of Green R., Wyo. Species of Colorado Basin. Scales 17–66–14 D. 8, A. 7

C. dissimilis Girard. Colo., Mont.

Platygobio physignathus Cope. Pueblo, Colo., where it is said to be the most common fish. Barbel distinct; D 8, A 8; scales 6–48–5, 20 before dorsal. Olivaceous above, white below, a plumbeous lateral band; fins plain. Length 6 inches.

P. gracilis Richardson. Milk R., Yellowstone R., etc. Length 12 inches. No dark lateral band.

Plagopterus argentissimus Cope. San Luis Valley, Colo.[1] D II. 7, A 10. Body entirely scaleless; color clear silvery, back dusky. Length 2½ inches.

The domesticated carp and goldfish have the dorsal fin elongate, and the dorsal and anal fins each preceded by a serrated spine. The carp (*Cyprinus carpio* L.) has four long barbels; the goldfish (*Carassius auratus* L.) has none. Both are of Old World origin.

Family Characinidæ

"A very large family of some 55 genera and 300 species, inhabiting the fresh waters of South America and Africa, where they take the place of the Salmonidæ and Cyprinidæ of the Northern Hemisphere" (Jordan and Evermann). Only one species occurs in the United States, namely *Tetragonopterus argentatus* (Baird and Girard), which I have obtained from North Spring River, Roswell, New Mexico.

[1] Jordan and Evermann describe this fish as inhabiting the Colorado basin in western Colorado. In this case the assigned type locality, the San Luis valley, may be doubtful, as this is in the upper Rio Grande basin. The fish is related to Pacific slope genera, not to anything in the Rio Grande. According to Gilbert it occurs at Fort Yuma.

ORDER **APODES** (The Eels)

FAMILY **Anguillidæ**

The common eel, *Anguilla chrysypa* Raf., is found in the Rio Grande. Girard separated the Rio Grande fish as a distinct species, *A. tyrannus*, but Jordan and Evermann treat it as a synonym.

ORDER **ISOSPONDYLI**

FAMILY **Chirocentridæ**

Portheus thaumas Cope, is from the Niobrara Cretaceous of Kansas, and perhaps of Colorado.

FAMILY **Hiodontidæ** (The Moon-Eyes)

Body oblong, much compressed, covered with brilliantly silvery scales. The moon-eye, *Hiodon alosoides* (Raf.), and the toothed herring, *H. tergisus* Le Sueur, have been found in Montana (*Henshall*). *H. alosoides* has the dorsal with 9 developed rays, *H. tergisus* has it with 12.

FAMILY **Clupeidæ** (The Herrings)

Six species occur in the Green River shales of Wyoming. These are *Diplomystus analis* Cope, *D. dentatus* Cope, *D. pectorosus* Cope, *D. theta* Cope, *Knightia alta* (Leidy), *K. eocæna* Jordan. The last is *Clupea humilis* Leidy, and *C. pusilla* Cope, both names preoccupied. Dr. Jordan justly objects to Dr. Dollo's proposal to rename *Diplomystus* Cope, calling it *Copeichthys* Dollo.

The genera of Green R. Clupeids are thus separated:

Dorsal scutes transverse, with pectinate borders, a median tooth especially prominent *Diplomystus* Cope.

Dorsal scutes not wider than long, with only a single median tooth, at the end of a longitudinal carina . . . . . *Knightia* Jordan.

The scales of *Knightia* are much larger than those of *Diplomystus*, about 35 in lateral line (over 60 in *Diplomystus*). (See Jordan, *Univ. of Calif. Publ., Geology*, Vol. V, No. 7, p. 136.)

The Museum of the University of Colorado contains good material of *D. analis*. There is also a well-preserved example of *Knightia eocæna*.

FAMILY **Salmonidæ** (Salmon and Trout)

Jaws toothless or nearly so; scales large . . . . . 1.

Dentition strong and complete . . . . . 3.

1. Olivaceous above, sides white, but not silvery; scales 8–74–9 (introduced in Flathead Lake, Montana) . . . . . *Coregonus clupeiformis* (Mitchill) (Whitefish).

   Bluish above, sides silvery . . . . . 2.

2. Scales in lateral line 83 to 87; length about a foot. (Great Basin and Pacific Slope, reaching Montana) . . . . . *Coregonus williamsoni* Girard. (Williamson Whitefish).

   Scales in lateral line 90; slenderer than the last, with lower fins. (Upper Missouri Basin in Montana) . . . . . *Coregonus cismontanus* (Jordan).

Henshall gives only *cismontanus* from Montana, calling it the Rocky Mountain Whitefish. However, *Coregonus couesii* Milner, which Jordan and Evermann refer to *williamsoni*, was from Chief Mountain Lake, Montana.

3. Black spotted species; vomer flat . . . . . 4.
   Spotted with red or gray; vomer boat-shaped . . . . . 10.
4. Scales typically large, in 120 to 130 cross series; but varying from 115 to 180; usually no red on throat; mouth small; size moderate (Montana, introduced) *S. irideus* Gibbons.
   Scales moderate, 130 to 180 cross series; no red on throat; mouth moderate; size very large (Montana, introduced) . . . . . *S. gairdneri* Richardson.
   Scales always small usually in about 160 (150 to 200) cross series; nearly always a large deep red or scarlet dash on each side concealed below inner edge of each dentary bone; mouth large (native species) . . . . . 5.
5. Black spots almost as numerous on head as on posterior part of body . 6.
   Black spots mainly on posterior part of body . . . . . 7.
6. Black spots encroaching somewhat on belly (both slopes of the Rocky Mts. in Montana, *Henshall*) . . . . . *S. clarkii* Richardson.
   Black spots not encroaching on belly (headwaters of Yellowstone Falls of Missouri R.) *S. lewisi* Girard.[1]

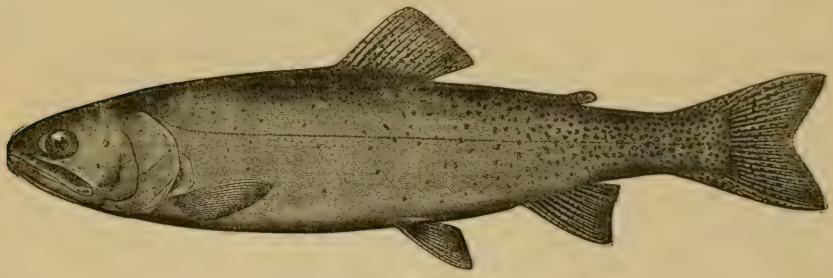

FIG. 6.—*Salmo macdonaldi.*

7. Scales not very small, about 160 in lateral line; spots of moderate size (Species of Rio Grande Basin, Colorado and New Mexico) . . . . . *S. spilurus* Cope.
   Scales very small, about 180 in lateral line . . . . . 8.
8. Spots rather large, lower fins distinctly red, rarely orange . . . . 9.
   Spots all small; lower fins bright yellow; a yellow lateral shade (Twin Lakes, Colo.) *S. macdonaldi* Jordan and Evermann.[2]
9. Spots very numerous; a red lateral band (Colorado Basin; western slope in Colo.) *S. pleuriticus* Cope.
   Spots few and large, chiefly on the tail (Arkansas and Platte Rivers; Boulder Creek. Boulder, Nov. 1907, *DeVoss and Perkins*) . . . . . *S. stomias* Cope.
   (*Salmo fario* L., the European Brown Trout, has been introduced in Montana.)
10. Vomer with a raised crest; spotted with gray, without bright colors; D 11, A 11 (Montana) . . . . . *Cristivomer namaycush* Walbaum,
    Vomer without raised crest; red-spotted, lower fins with bright edgings. 11.

[1] "One of the present writers has caught them in the very act of going over Two-Ocean Pass from Pacific into Atlantic drainage" (JORDAN AND EVERMANN, *American Food and Game Fishes*, p. 179).

[2] A small Crustacean, *Diaptomus judayi* Marsh, is also confined to Twin Lakes, so far as is known.

11. Back unspotted, but strongly marbled with dark olive or black; dorsal and caudal fins mottled (Allen's Park, Boulder Co., Colo., September 6, 1907. *S. A. Rohwer*, doubtless introduced; Montana, introduced) . . *Salvelinus fontinalis* Mitchill. (Eastern Brook Trout.)

Back with red spots, like those on sides, but smaller and usually paler; no dark marbling above (West Montana, native) . . . . . *Salvelinus parkei* Suckley. (*malma* auctt., not Walbaum) (Dolly Varden Trout).

FAMILY **Gonorhynchidæ**

Notogoneus osculus Cope, is from the Green River shales.

FAMILY **Osteoglossidæ**

Phareodus acutus Leidy, is from the Bridger Eocene of Wyoming. *P. æquipinnis* (Cope), *P. encaustus* (Cope), and *P. testis* (Cope), are from the Green River beds of Wyoming. *Dapedoglossus* Cope, is the same genus.

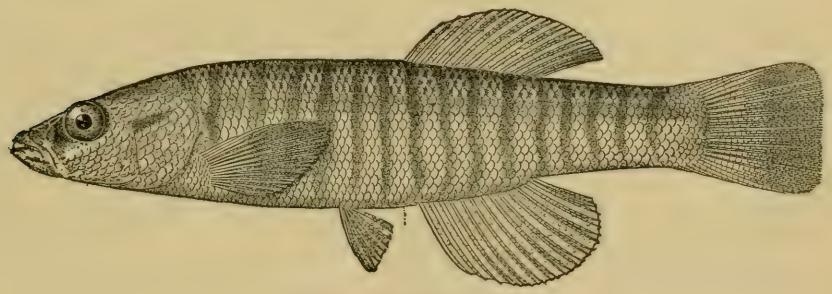

FIG. 7.—*Fundulus zebrinus.*

FAMILY **Thymallidæ** (The Graylings)

The Montana Grayling, *Thymallus ontariensis montanus* (Milner), occurs in the tributaries of the Missouri River in Montana. Dr. Henshall, following Milner, treats this as a distinct species, *T. montanus*. It is in fact separated by a long distance from the habitat of *T. ontariensis* in Michigan, and should logically stand as a species, but its distinctive characters are few. Jordan and Evermann say: "Entirely similar to the Michigan grayling, but the dorsal a little smaller."

ORDER **HAPLOMI**

FAMILY **Luciidæ** (The Pikes)

Ischyrhiza antiqua Leidy, is from the Fox Hills Cretaceous of New Mexico.

FAMILY **Pœciliidæ** (The Killfishes)

Sides with many dark crossbars; dorsal rays 14 or 15 (Boulder County, *Juday;* Pueblo, Colo.; New Mexico) . . . . . *Fundulus zebrinus* Jordan and Gilbert.

Brownish, finely dotted; lips, top of head, and line along middle of back dark; dorsal rays 11 (Wyoming) . . . . . *F. lineatus* Garman.

Olive gray, scales with ochre borders; fins yellow, edged with red; dorsal rays 10 (Boulder County, *Juday;* Denver, Colo.; Arkansas R.) . . . . *F. floripinnis*, Cope.

Order **HEMIBRANCHII**

Family **Gasterosteidæ** (The Sticklebacks)

The Brook Stickleback, *Eucalia inconstans* (Kirtland), is reported by Henshall from Poplar R., Montana. It has 4 or 5 dorsal spines.

Order **ACANTHOPTERI** (The Spiny-Rayed Fishes)

Family **Aphredoderidæ** (The Pirate Perches)

Dorsal fin single, with few small spines. Vent anterior, its position varying with age, from just behind the ventral fins in the young, to below the preopercle in the adult. One genus and species among living fishes, confined to the eastern United States. The group is so distinct that Jordan and Evermann place it in a distinct suborder, Xenarchi.

No less than four genera of these fishes have been described by Cope from the Rocky Mountain Tertiaries. Jordan and Evermann remark that these fossil genera "seem to stand between *Aphredoderus* and *Elassoma*, which seem to be near relatives on the one hand, as *Percopsis* is on the other."

The fossils are:

Trichophanes foliarum Cope, and *T. copei*, Osborn, Scott and Speir, Miocene shales of Florissant, Colorado.

Amphiplaga brachyptera Cope, *Asineops pauciradiatus* Cope, *A. squamifrons* Cope, *Erismatopterus endlichii* Cope, *E. levatus* Cope, and *E. rickseckeri* Cope, all from the Green River beds of Wyoming.

Family **Mugilidæ** (The Mullets)

Two short dorsal fins, well separated, the anterior with four stiff spines, of which the last is much the shortest.

Pelecorapis berycinus Cope, is from the Pierre Cretaceous of Montana.

Syllæmus latifrons Cope, is from the Benton Cretaceous, doubtfully of New Mexico.

Family **Centrarchidæ** (The Sunfishes)

Body more or less shortened and compressed. Dorsal fins confluent.

Jordan and Evermann say: "fresh-water fishes of North America; genera 12; species about 30, forming one of the most characteristic features of our fish fauna." They appear to be very few in the vicinity of the Rocky Mountains, however.

Dorsal fin scarcely longer than anal; silvery olive, mottled with clear olive green (Boulder County, introduced: *Juday*) . . . . . *Pomoxis sparoides* (Lacép.) (Calico Bass).

Dorsal fin much larger than the anal . . . . . 1.

1. Body comparatively elongate, the depth of adult about one-third the length; dorsal fin low, deeply emarginate, with 10 spines . . . . . 2.
   Body comparatively short and deep; dorsal fin not deeply emarginate 3.
2. Mouth moderate; young more or less barred or spotted, never with a black lateral band (introduced in Montana) . . . . . *Micropterus dolomieu* Lacép. (Small-mouthed Black Bass).
   Mouth large; young with a blackish lateral band (introduced in Boulder Co., Colo., and Montana) . . . . . *Micropterus salmoides* Lacép. (Large-mouthed Black Bass).

3. Dorsal spines strong and high, the longest usually longer than snout and eye; olive green, adults dark; sides with undulating greenish bars, becoming obsolete in adult (Rio Grande) . . . . . *Lepomis pallidus* (Mitchill) (Blue-gill).
Dorsal spines low, the longest little longer than snout . . . . . 4.
4. Brilliant blue and orange, the back chiefly blue, the belly entirely orange; cheeks orange with bright blue stripes; length 8 inches. (Rio Grande) *Lepomis megalotis* (Raf.) (Long-eared Sunfish).

The prevailing shade green, with a strong brassy luster on sides, which becomes nearly yellow below; each scale usually with a blue spot. (Boulder County, *Juday;* Rio Grande) . . . . . *Apomotis cyanellus* (Raf.) (Blue-spotted sunfish).

Spirit specimens of *Apomotis cyanellus* are a sort of bluish-gray or pale plumbeous, with a faint lattice-marking, and scattered small dark spots. The fish is quite unlike any other native in Boulder County.

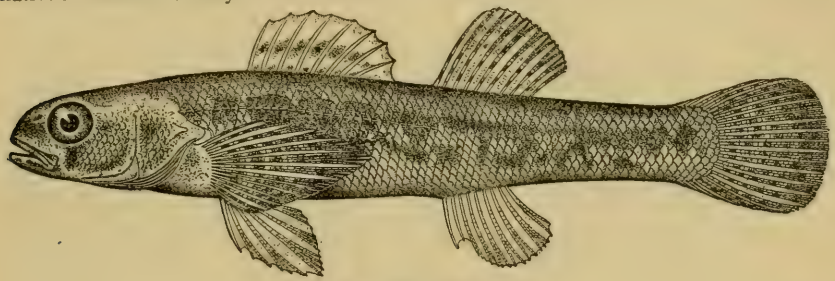

FIG. 8.—*Etheostoma iowæ.*

FAMILY **Percidæ** (Perch Family)

Mioplosus Cope, is a genus of the Green River Shales of Wyoming, with the following species: *M. abbreviatus* Cope, *M. beani* Cope, *M. labracoides* Cope, *M. longus* Cope, *M. sauvageanus* Cope.

The living forms are as follows:

Large fishes, with preopercle serrate; mouth large, terminal . . . . . 1.
Small fishes, preopercle entire or nearly so . . . . . 2.

1. Canine teeth none; body oblong; ventral fins near together; back dark olivaceous, sides golden yellow, with 6 or 8 dark bars (Montana, introduced) *Perca flavescens* Mitchill (Yellow Perch).

Canine teeth on jaws and palatines; body elongate, head with a snakelike aspect (Upper Missouri R.) . . . . . *Stizostedion canadense boreum* Girard. (Northern Pike-Perch).

2. Only one anal spine (A I, 7 to 9); length of fish about or nearly 70 mm.; scales larger than in *E. iowæ*, about $1\frac{2}{5}$ mm. across; eye about $1\frac{2}{3}$ mm. from mouth; dorsal fins touching, or slightly separated; parietal region of head concave. (Boulder Co., *Juday*) *Boleosoma nigrum* Raf.

Two anal spines; anal rays 6 to 8 . . . . . 3.
3. Humeral region with a distinct black process or scale; scales 46 to 55 in lateral line; snout much shorter than eye (Cañon City, Colo.) . *Etheostoma cragini* Gilbert.
Humeral region with at most a faint dark spot . . . . . 4.

4. Head entirely scaleless; scales 6–48 to 54–8; olivaceous, with dark blue bars. (Dimmit Lake, near Roswell, N. M., *Cockerell*). *Etheostoma lepidum* Baird and Girard.
Head partially scaly; scales 5–55 to 63–11; length about 55 mm.; scales a little over 1 mm. across; eye about $\frac{2}{3}$ mm. from mouth; dorsal fins distinctly separated. (Boulder Creek, Boulder, Nov. 1907.) . . . . *Etheostoma iowæ* Jordan and Meek.[1]

FAMILY **Pomacentridæ** (The Demoiselles)

Fishes of tropical seas. Nostril single on each side, nearly round, a character "shared with the *Cichlidæ* only, from ancestors of which group the *Pomacentridæ* are probably descended."

Priscacara Cope is a genus of the Green River shales in Wyoming, with these species: *P. clivosa* Cope, *P. cypha* Cope, *P. hypsacantha* Cope, *P. liops* Cope, *P. oxyprion* Cope, *P. pealei* Cope, *P. serrata* Cope. A good example of *P. liops* (with, however, 14 caudal vertebræ instead of 13) is in the Museum of the University of Colorado (Maxwell collection).

FIG. 9.—*Cottus punctulatus.*

ORDER **PLECTOGNATHI**

FAMILY **Cottidæ** (The Sculpins)

Caudal peduncle very slender, its least depth not much greater than diameter of eye; body and head profusely speckled (Green River, Wyoming). *Cottus punctulatus* Gill.
Caudal peduncle deep, its least depth equal to length of snout; back and sides less distinctly speckled . . . . . 1.

1. Head blunt, low, rounded anteriorly; body with vague dark clouds and specks. (Colorado, New Mexico, Wyo., Mont.)
Cottus semiscaber Cope (Rocky Mountain Bullhead).
Head less rounded, with a median depression; body usually with broad, oblique, dark bars; small and slender; the spinous dorsal very low. (Swan R., Montana, *Linton*, possibly in error for *semiscaber*) . . . . *Cottus ictalops bairdii* Girard.

FAMILY **Gadidæ** (Codfish Family)

Scales small, cycloid; mouth large; chin with a barbel. Marine, except *Lota*. Anal fin not notched; length of fish 2 feet; barbel longer than eye (Montana).
Lota maculosa Le Sueur (Burbot or Ling).

[1] *E. iowæ* seemed far out of range, but I sent a speciman to Dr. Evermann, and he reports that it agrees well with typical specimens from Iowa and Nebraska.

THE SANDSTONE OF FOSSIL RIDGE IN NORTHERN COLORADO AND ITS FAUNA

By Junius Henderson

Fossil Ridge is a low ridge of sandstone extending in an approximate north-south direction for several miles, lying between the Colorado and Southern Railway track and the Ft. Collins-Loveland wagon road, south of Ft. Collins. Fossil Creek cuts through the ridge about five miles south of Ft. Collins, near where the ridge in its northward extension passes into the general level of the divide and thus disappears. Weathered out on the surface of this sandstone are innumerable hard, sandy concretions, from a few inches to four feet in diameter, containing large numbers of fossils, which have given to the ridge and creek the names they bear. The large size and abundance of some of the species attract the attention of even the most unobserving traveller who passes over the ridge. In the early reports the locality was variously called Fossil Ridge and Fossil Creek. As the ridge follows a definite stratigraphic horizon, while the creek cuts across strata several thousand feet in thickness, the former name seems preferable in a geological sense.

This vicinity is of peculiar interest to the paleontologist as the type locality of some interesting forms, as well as because of the pronounced intermingling of Pierre and Fox Hills species. A correct understanding of this and related sandstones may also have a very practical value in the exploration for oil.

These beds seem to occupy a position about one-third of the way up from the bottom of the Ft. Pierre Cretaceous. As the Pierre in this region is from 5,000 to 7,000 feet in thickness, the importance of finding narrow, persistent, identifiable horizons, either lithological or paleontological, within the formation, is at once apparent. Oil of excellent quality and in paying quantities is found in the Pierre at several places in Colorado, as at Boulder and Florence. There is every reason to believe that the production of petroleum may be greatly increased by

intelligent prospecting along the plains bordering the foothills of eastern Colorado, but the prospecting thus far has resulted in a vast amount of dead work upon which the comparatively few producing wells must pay interest in order to make the industry on the whole a profitable one. The accumulation of oil in the rocks is known to be controlled largely by folds. The great thickness of this formation, its homogeneity and the lack of closely connected outcrops over large areas render the accurate determination of such structural features very difficult. For this and other reasons the prospecting has thus far been carried on chiefly by haphazard boring, the location of many borings having been based upon the use of the "bobber," the finding of horseshoes and rabbit tracks and other superstitious methods. In consequence many holes have been put down where more thorough and systematic prospecting would have shown their probable folly and more likely ground has been wholly overlooked. Where the oil is reached at a depth of hundreds of feet, as here, the expense of dry holes is an item to be seriously considered. Hence the growing demand for a better understanding of the Pierre formation.

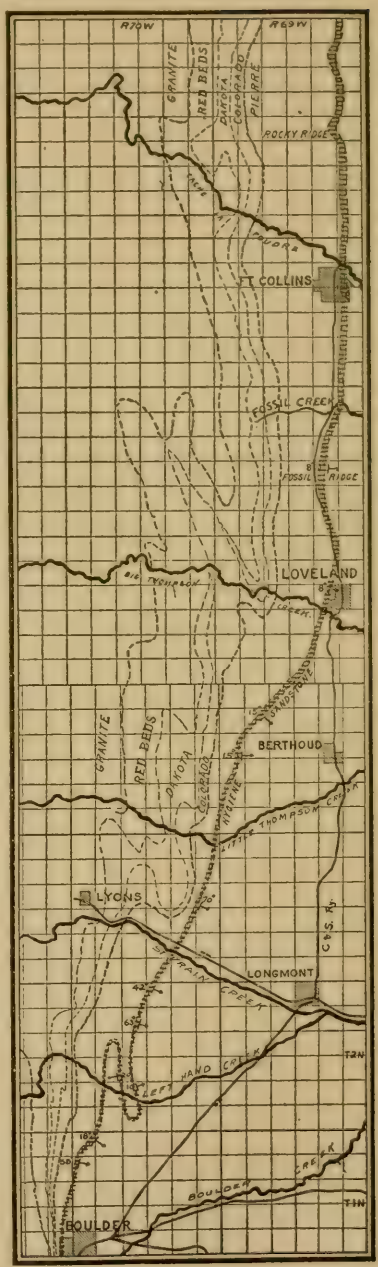

FIG. 1.—Map showing relation of Hygiene sandstone to older formations of foothills, prepared by Mr. H. F. Watts from the writer's data.

The importance of a thorough understanding of the Cretaceous sandstones in connection with irrigation projects and the utilization of the high, dry plains is also becoming more and more apparent. These sandstones absorb great quantities of water from ditches and reservoirs, carrying it off beneath the surface, to reach the surface again perhaps far away from the point of entrance. As the demand for water for irrigation increases the necessity of stopping this seepage by avoiding the sandstones or cementing over them will increase. On the other hand, experience proves that a thorough knowledge of these sandstones and their relations to overlying and underlying formations will greatly simplify the problem of wells for minor irrigation and stock watering on the divides which cannot practically be reached by ditches from streams.

This paper is not intended as a complete solution of any of these problems, but merely to record at least a portion of our present knowledge of an important member of the Pierre Group, which may be of assistance to future workers in the field.

Emmons, Cross and Eldridge long ago reported a persistent sandstone in the lower Pierre of the Denver Basin. More recently Dr. Fenneman described more in detail a sandstone in the lower Pierre of the Boulder District, which he called the Hygiene, extending from the northern part of the area covered by the Denver Basin monograph to a point west of Berthoud, which is likely a continuation of the one in the Denver Basin. Early in our work upon Fossil Ridge the writer was impressed with the possibility that it was a continuation of the Hygiene sandstone. Against this idea were two facts, the distance of Fossil Ridge from the foothills and the presence therein of numbers of Fox Hills species which are not found in the Pierre of the Boulder District. The first objection is explained away by our investigations, but the other is still unexplained. The Niobrara formation is found quite uniformly at the base of the first slope of the foothills. By referring to the map herewith it will be noted that the Hygiene at Boulder is within one-fifth of a mile of the Niobrara outcrop, while nine miles farther north it is about two miles distant with a dip of 63 degrees. Opposite the Rabbit Mountain fold east of Lyons we found it again within one-half mile of

the Niobrara with a dip of 70 degrees. This difference in relative position is due chiefly to folds and difference in dip, though possibly there is also some difference in the thickness of the underlying portion of the Pierre shales, as it would not be likely to retain the same exact thickness for such distances. From the Rabbit Mountain outcrop the sandstone continues northward with a dip of about 15 degrees, exposed at intervals about a mile from the Niobrara outcrop, to a point west of Berthoud whence it is thrown rapidly to the eastward in its northward extension, the sudden change in strike being due chiefly to a change in direction of dip produced by the Arkins fold. At the same time the distance from the foothills increases to an average of nearly three miles, largely in consequence of the flattening of the dip, which in places from Loveland northward falls as low as eight degrees and north of Ft. Collins drops to five degrees. The sandstone passes into the Big Thompson Valley about half a mile southeast of Loveland and is covered by river débris, but outcrops again on the north side of the valley immediately northeast of town at the south end of Lake Loveland, there occupying almost exactly the same relative position with reference to the Niobrara as at Fossil Ridge, and containing numbers of *Inoceramus oblongus*, *Anomia rætiformis* and *Scaphites nodosus*, so characteristic of Fossil Ridge. We found there, too, a tendency toward concretionary structure of the sandstone, though not so pronounced as at Fossil Ridge. From this point the sandstone is traceable directly into Fossil Ridge, leaving little chance for doubt that Fossil Ridge is a continuation of the Hygiene sandstone. We have not traced the sandstone across the Cache la Poudre Valley, but from where it disappears on the south side of the valley we passed northward through Ft. Collins and found it exactly where it should occur on the north side of the valley, in every respect the same as at Fossil Ridge, including the typical concretions and their fossils. From Loveland northward the strike is almost due north as far as we traced it. North of Ft. Collins it passes along the east shores of Terry Lake, Rocky Ridge Reservoir No. 1 and Douglas Lake Reservoir No. 10; the cutting away of the sandstone at the two latter places by undermining from the west forms a steep west-facing bluff which slopes from the escarpment gently eastward. This is called Rocky Ridge. While the

strike of this sandstone is uniformly north in the northern part of the field, its distance from the foothills varies more or less on account of the sinuous strike of the foothills formations, which is due to important folds, their failure to materially affect the strike of the Hygiene sandstone perhaps being due to the yielding nature of the intervening Pierre shales.

Both above and below the harder ridge-making portion of the Hygiene everywhere are softer sandstones, and a short distance to the eastward is a more or less persistent sandstone which forms a marked ridge east of Fossil Ridge and Rocky Ridge.

The fact that this sandstone is continuous from Boulder to Rocky Ridge does not render entirely necessary the conclusion that the former at Boulder and the latter at Ft. Collins are synchronous, though no evidence has been found to the contrary. In this region the Pierre formation, together with the overlying Fox Hills and the underlying Niobrara and Benton, are marine, as shown by the unvarying evidence of the fossils contained therein. The base of the Pierre all along the plains adjacent to the foothills consists of black shales to a thickness of hundreds of feet, the conditions under which they were deposited having been quite uniform throughout the region.

Among the possible changes which could have caused the temporary and widespread deposition of sandstone instead of shales may be mentioned: (*a*) an unlift of the adjacent land surface, so that coarser materials would be carried seaward by the streams; (*b*) the cutting away of certain formations on the land surface so as to expose to erosion materials of different character; (*c*) the shallowing of the sea, either by uplift or sedimentation, and consequent increase of the power of waves and along-shore currents; (*d*) the increase of currents from any other cause.

That the sandstones were laid in somewhat quiet water is evident from the unbroken and unworn condition of the fossils, even such fragile shells as *Anomia rætiformis* Meek. The bivalves also are mostly found with the valves in juxtaposition. We have seen very few specimens which showed evidence of having been broken before being buried, the only really noteworthy case being a bryozoan on a fragment of *Placenticeras* in such position as to show that it lived on the shell after it was

broken. Quiet water is also indicated by absence of cross-bedding and coarse material.

While it may be true that the two sandstones are not absolutely synchronous, on the whole it seems quite probable that they are. The two seem to occupy the same positions with reference to the overlying Fox Hills sandstones and the underlying Niobrara limestone. The fauna of the Fossil Ridge district bears a much closer resemblance to that of the Fox Hills formation than does that of the Hygiene horizon at Boulder, but the absence of many of the Fox Hills species from the Boulder District may be due to local conditions existing during Pierre time, though more likely the apparent difference is due to the less fossiliferous character of the outcrops in the Boulder District. The paleontologic evidence is not sufficient to overcome the direct stratigraphic evidence.

Analysis of Fossil Ridge Fauna

The following species have almost no value in this connection, for various reasons, many of them being found in only one or two localities and consequently their geological range being but little known:

Beaumontia solitaria
Chætetes dimissus
Serpula n. sp.
Panopæa berthoudi
Ostrea patina
Anatina n. sp.
Capulus n. sp.
Gyrodes crenata
Anchura haydeni
Volutoderma n. sp.
Anisomyon centrale

Halymenites major is said to range as low as the Benton and is common in the Fox Hills sandstone, so that it is without value in this discussion.

Baculites compressus and *Scaphites nodosus* have been found just below the Hygiene at Boulder.

The following have been found immediately above the Hygiene at Boulder:

Inoceramus oblongus
Inoceramus proximus
Inoceramus vanuxemi
Ostrea inornata
Anomia rætiformis
Callista deweyi
Anisomyon borealis
Nautilus dekayi
Placenticeras whitfieldi

FIG. 2.—General view of Fossil Ridge about seven miles south of Ft. Collins, showing the massive sandstone with weathered out fossiliferous concretions lying on surface.

FIG. 3.—Concretion in foreground of Fig. 2, containing *Inoceramus oblongus* measuring from six to eight inches in length.

Baculites ovatus, *Inoceramus barabini* and *Avicula linguiformis* have been reported to range through the Pierre and into the Fox Hills.

The following are in other localities usually confined to upper Pierre or Fox Hills, or both, and have not been found in or immediately above the Hygiene at Boulder:

Ostrea pellucida
Volsella meekii
Thracia gracilis
Scaphites nicolletii
Margarita nebrascensis
Anchura americana
Anisomyon patelliformis

The following, though we have found them elsewhere in northern Colorado only in Upper Pierre and Fox Hills strata, are known in other regions to range low in the Pierre, according to Dr. T. W. Stanton (MSS):

Avicula nebrascana
Cardium speciosum
Placenticeras intercalare
Pholodomya subventricosa
Tellina scitula

From the foregoing it seems clear that the fauna itself is not determinative of the exact horizon, so that we must rely upon the stratigraphic evidence.

Professor D. W. Spangler, Messrs. G. S. Dodds, Harvey C. Markman and Harry W. Clatworthy have rendered notable assistance in this work, particularly in the search for fossils. The writer also wishes to express appreciation of the great assistance rendered by Dr. T. W. Stanton, of the United States Geological Survey, in the identification of material and in advice on various matters, and the assistance of Professor R. P. Whitfield in identifying a few specimens. Descriptions are in preparation of several new species found at Fossil Ridge.

Partial Bibliography

The following works bear either directly upon the sandstones in question or contain descriptions, figures or discussions of species found at Fossil Ridge:

Cross, Whitman. *See* Emmons.

Eldridge, George H. *See* Emmons.

Emmons, Samuel F., Whitman Cross and George H. Eldridge. *Geology of the Denver Basin.* U. S. Geol Sur., Mon., Vol. XXVII, 1896. Discusses the Cretaceous formations in detail, mentions sandstone probably same as Hygiene and contains list of fossils on pp. 78, 79.

FENNEMAN, N. M. *Geology of the Boulder District, Colorado*, U. S. Geol. Sur., Bull. No. 265, 1905. Discusses, *inter alia*, the Hygiene sandstone.

HENDERSON, JUNIUS. "Paleontology of the Boulder Area." *Univ. of Colo. Studies*, Vol. II, No. 2, pp. 95–106, 1904.

——— "Scientific Expedition to Northeastern Colorado. II, Paleontology—Account of Collections Made." *Univ. of Colo. Stud.*, Vol. IV, No. 3, pp. 149–152, 1907.

KNOWLTON, FRANK HALL. *Flora of the Montana Formation.* U. S. Geol. Sur., Bull. No. 163, 1900. Discusses *Halymenites major.*

MEEK, F. B. *A Report on the Invertebrate Cretaceous and Tertiary Fossils of the Upper Missouri Country.* U. S. Geog. and Geol. Sur. of the Terr. ("Hayden Survey"), Mon., or Fin. Rept., Vol. IX, 1876. Descriptions and figures of the majority of our species are contained in this volume.

——— *United States Geological Exploration of the Fortieth Parallel* ("King Survey"), Fin. Rept., Vol. IV, Pt. II, "Paleontology," 1877. Describes and figures many of our species, including *Anomia rætiformis*, from Fossil Ridge.

STANTON, T. W. "Paleontological Notes." *Proc. Colo. Sci. Soc.*, Vol. II, pp. 184–187, 1888. Discusses Pierre fossils north of Boulder.

STANTON, T. W., and KNOWLTON, F. H. *Geology and Paleontology of the Judith River Beds*, U. S. Geol. Sur., Bull. No. 257. Contains a discussion of distribution of some so-called Fox Hills species and the relation of the Western Cretaceous formations.

WELLER, STUART. *Geological Survey of New Jersey: Paleontology*, Vol. IV, 1907. On pp. 683–686 is a discussion of *Gyrodes*, two species of which are in our list.

WHITE, CHARLES A. "Report on the Paleontological Field Work for the Season of 1877," *U. S. Geog. and Geol. Sur. of the Terr.* ("Hayden Survey"), *11th Ann. Rept.* (for 1877), pp. 161–319. Lists 13 species from Fossil Ridge.

——— "Contributions to Invertebrate Paleontology, No. 2: Cretaceous Fossils of the Western United States and Territories." *Ia., 12th Ann. Rept.* (for 1878), Pt. I. pp. 1–39.

(These two papers describe and figure some of our Fossil Ridge species.)

WHITFIELD, R. P. *Gastropods and Cephalopods of the Raritan Clays and Greensand Marls of New Jersey*, U. S. Geol. Sur., Mon., Vol. XVIII, 1891. Contains descriptions and figures of a number of our species and on page 32 discusses the stratigraphic relations of the Pierre and the Lower Marls.

SYSTEMATIC PALEONTOLOGY

PLANTS

Halymenites major Lx.

This sparsely branching seaweed, covered with tubercles and easily recognized, is very abundant in these beds from Rocky Ridge, six miles north, to Fossil Ridge, six miles south, of Ft. Collins, and in a higher sandstone east of Fossil Ridge. None found in the Pierre of the Boulder District, but abundant in the Fox Hills beds from Denver Basin northward. Found from top of Benton to Fox Hills, or perhaps Tertiary [Frank Hall Knowlton, *Flora of the Montana Formation*, U. S. Geol. Sur., Bull. No. 163, pp. 17, 18], and hence useless in the determination of the stratigraphic position of any member of the Pierre.

Fragments of undetermined fossil wood are common south of Ft. Collins, often honeycombed by *Teredo* or other wood-boring mollusks. There are also casts of perfectly round, smooth, straight plant stems, undetermined.

ANIMALS

CŒLENTERATA

Beaumontia solitaria White

Fossil Ridge is the type locality for this species. We have not seen it and find no other record except a conglomerate pebble in the Denver Beds.

Chætetes dimissus White

The type locality is Fossil Ridge, where it is abundant. Not recorded elsewhere, but we found it common also at the same horizon at Rocky Ridge, north of Ft. Collins.

ANNELIDA

Serpula n. sp.

Common at Fossil Ridge, the type locality, and at Rocky Ridge. Have not seen it elsewhere. An undetermined *Serpula* reported from the lower Pierre of the Denver Basin may be of this species, but we have not seen specimens of it.

POLYZOA

Membranipora sp.

An undetermined species found on fragments of *Anchura* and *Placenticeras* at Fossil Ridge, in the latter case in such position as to show growth after the cephalopod had been broken up. We found the same or a similar species on *Baculites* below the Hygiene sandstone at the mouth of Little Thompson canyon, northeast of Lyons.

MOLLUSCA

PELECYPODA

Panopæa berthoudi White

Described as *Glycimeris berthoudi* by Dr. White, but belonging to the genus *Panopæa*, following Dr. Dall's able treatment of that and related genera, which appears to be generally accepted. The type locality of this species is Fossil Ridge. We are aware of no other records, but have received several specimens collected near Meeker, Colorado, by Professor F. H. Hopkins.

Pinna lakesi White

The type locality is Fossil Ridge, where it is quite common. We know of no other records except one in Canada [J. F. Whiteaves, *Contributions to Canadian Paleontology*, Vol. I, Pt. I, p. 84, 1885, "Geol. and Nat. Hist. of Canada"], but have seen one other specimen collected near Meeker, in northwestern Colorado, by Professor F. H. Hopkins.

Inoceramus crippsii var. **barabini** Morton

Numbers of specimens are found at Fossil Ridge. In Boulder District and at Loveland and Berthoud it is found in, below and above the Hygiene sandstone. In the Denver Basin monograph the species is credited to the Fox Hills and upper and middle Pierre, but from Boulder to five miles north of Ft. Collins we have found it in the lower third of the Pierre and have seen no examples in Fox Hills strata. In the upper Missouri region it is found in Pierre strata (Meek).

Inoceramus oblongus Meek

This large shell, many examples measuring from eight to ten inches in length and six inches in breadth, is the most abundant species in the Hygiene beds from Lake Loveland to Rocky Ridge. Frequently a dozen are found in a single concretion. We have found a few just above and possibly in the Hygiene sandstone in the Boulder District, but by no means as robust as the more northern examples. It would be interesting to know the difference in conditions which made this species so abundant and large near Ft. Collins. It is enormously variable, particularly in the ratio of breadth to length. Our fine series passes by minute gradation from extremely compressed to highly inflated forms, the majority, however, being much inflated. Reported also from near Morrison, Colorado (White). We have no other records.

Inoceramus sagensis Owen

Quite common at Fossil Ridge and Rocky Ridge. We have found it in large numbers just above the Hygiene sandstone from three to eight miles north of Boulder and a few in that sandstone. Found in the Pierre of upper Missouri region (Meek).

Inoceramus proximus? Tuomey

One specimen from Fossil Ridge is doubtfully referred to this species, and a few from above the Hygiene sandstone at Haystack Butte north of Boulder. Found in the lower Pierre of the upper Missouri region (Meek).

Inoceramus vanuxemi M. and H.

Recorded from Fossil Ridge by Dr. White and we have two or three specimens from there. It is very abundant in two or three thin calcareous sandy strata above the Hygiene sandstone three miles north of Boulder and we have seen one or two excellent specimens in that sandstone itself at Haystack Butte. Found in Pierre of upper Missouri region (Meek).

Avicula linguiformis E. and S.

Common at Fossil Ridge and a few found at Rocky Ridge. In the Denver Basin monograph this species is credited to the upper Fox Hills. In Dr. White's list it appears as *Pteria linguiformis*. "Ranges through the Fort Pierre and Fox Hills Groups" in the upper Missouri region (Meek).

Avicula nebrascana E. and S.

We found one specimen at Fossil Ridge, a few above the Hygiene sandstone at the brick kiln near University Campus in Boulder and four miles north of Boulder, and a large number at the top of the Pierre shales four miles southeast of Windsor. Some of the early literature of western paleontology records this as *Pteria nebrascana*. Found in upper Pierre and Fox Hills in the upper Missouri region (Meek.)

Ostrea inornata M. and H.

We have one or two examples from Fossil Ridge. It is abundant just above the Hygiene sandstone from three to seven miles north of Boulder and west of Berthoud. In La Plata quadrangle it is reported from the upper Mancos formation, the probable equivalent of lower or middle Pierre. [Whitman Cross, Arthur Coe Spencer and Chester Wells Purington, *La Plata Folio, Geologic Atlas of the United States*, U. S. Geol. Sur., Fol. 60, p. 5, 1899.] Found in the upper Pierre of the upper Missouri River region (Meek).

Ostrea patina M. and H.

Rather common on Fossil Ridge from five to seven miles south of Ft. Collins. We have seen none elsewhere and find no other records for Colorado. Found in the Pierre of the upper Missouri River region (Meek).

Ostrea pellucida M. and H.

Rather common on Fossil Ridge. Not noticed in the Boulder District. Reported from the Mesa Verde formation, in La Plata Quadrangle. [Cross, Purington and Spencer, *Folio 60, Geol. Atlas of the United States, supra*, p. 5.] Found in the Fox Hills of the upper Missouri River region (Meek).

Anomia rætiformis Meek

Abundant in the Hygiene sandstone from Lake Loveland to Rocky Ridge. Fossil Ridge is probably the type locality, which is described as a "ridge southeast of La Porte." [Meek, *Fortieth Parallel Survey*, Vol. IV, Pt. I, p. 141.] Found occasionally above the Hygiene sandstone in the Boulder District.

Volsella meekii E. and S.

We found a number on Fossil Ridge from five to seven miles south of Ft. Collins. Not seen by us or recorded elsewhere in the state. Found on Yellowstone River in strata containing a blending of Pierre and Fox Hills species (Meek).

Pholodomya subventricosa M. and H.

We found one specimen five miles south of Ft. Collins on Fossil Ridge, and two at what is usually considered the upper limit of the Pierre southeast of Windsor. It is found in either the Eagle or Claggett formation (Stanton MSS, reported by Meek as Fox Hills) on the Judith River, Montana.

Anatinau sp.

Fossil Ridge, seven miles south of Ft. Collins, is the locality where we first found this shell. We also found one small specimen at the same horizon at Rocky Ridge, and several near the top of the Pierre as its limits are generally understood in Northern Colorado, southeast and southwest of Windsor.

Thracia gracilis M. and H.

We found several specimens on Fossil Ridge from five to seven miles south of Ft. Collins. We are aware of no other records or specimens from Colorado. It is found in the Claggett formation (Stanton MSS, reported by Meek as Fox Hills) near the mouth of Judith River, Montana.

Neæra? sp.

A single specimen not specifically identifiable but probably referable to this genus we found in the Fossil Ridge sandstone south of Ft. Collins.

[*Veniella humilis* M. and H.

The record of this species was based upon a cast of a single valve, which we have recently examined and find its identity not certain enough to warrant the retention of the record. The species is abundant at the top of the Pierre east of Fossil Ridge, southeast of Windsor.]

[*Lucina occidentalis* Morton

This record was based upon specimens so labelled in the University collections. An examination shows that they are *Callista deweyi* M. & H., a common Fossil Ridge species. However, this *Lucina* is found at about the same horizon at Boulder.]

Cardium speciosum M. and H.

Abundant at Fossil Ridge and Rocky Ridge. We have not found it elsewhere below the upper Pierre, but it is abundant throughout the Fox Hills formation from Boulder Creek to the Cache la Poudre. Found in Eagle and Claggett formations, equivalent to lower Pierre (Stanton MSS, reported by Meek as Fox Hills) on the Judith River, Montana.

Callista deweyi M. and H.

Common at Fossil Ridge and Rocky Ridge. We have found a number immediately above the Hygiene sandstone three miles north of Boulder. In the Denver Basin monograph it is credited to Fox Hills strata. In a former paper [*University of Colorado Studies*, Vol. II, p. 104] the writer listed this species from Fossil Ridge as *Lucina*, by a curious oversight. It is found on the Yellowstone River in strata containing a blending of upper Pierre and Fox Hills fossils (Meek).

Tellina scitula M. and H.

We have a single valve from Fossil Ridge, a species we have found in the Fox Hills sandstone at every exposure examined from the Denver Basin to the Cache la Poudre. It is recorded from Fox Hills strata also in the Upper Missouri region (Meek), and Dr. Stanton (MSS) reports it from low in the Pierre elsewhere.

Mactra sp.

A small specimen not specifically determinable, probably juvenile, we found on Fossil Ridge seven miles south of Ft. Collins.

Teredo? sp.

Fossil wood is found on Fossil Ridge containing casts of borings resembling those of *Teredo* or *Parapholas*.

GASTEROPODA

Margarita nebrascensis M. and H.

Abundant at two or three places along Fossil Ridge. We are not aware of its occurrence elsewhere in Colorado. Found on the Yellowstone River in Pierre and Fox Hills strata (Meek).

Capulus n. sp.

Fossil Ridge is the only locality in which we have found this species, and only two adults and one juvenile were found.

Gyrodes abyssina Morton

A single specimen of this species from Fossil Ridge was heretofore recorded as *Lunatia* sp., but Professor R. P. Whitfield has since shown its identity with the New Jersey species. Like *Gyrodes crenata* Conrad, it is found in the Lower Marls of New Jersey, forming additional threads in the strand of evidence connecting those beds with the Pierre shales in point of time. [Whitfield, *U. S. Geol. Sur.*, *Mon.*, Vol. XVIII, pp. 32, 123, 125; Weller, *Geol. Sur. of New Jersey*, *Paleontology*, Vol. IV, pp. 683–685.]

Gyrodes crenata Conrad

We have a single specimen found at Fossil Ridge. Identified by Professor R. P. Whitfield as *G. infracarinata* Gabb, which appears equivalent to Conrad's species. [Weller, *Geol. Sur. N. J.*, *Paleontology*, Vol. IV, pp. 685–686.] As to its occurrence elsewhere, see *Gyrodes abyssina*.

Gyrodes sp.

One example belonging to this genus but specifically undetermined was found at Fossil Ridge. It is distinct from either of the foregoing.

Anchura haydeni White

Fossil Ridge is the type locality of this fine species. A specimen has been reported at Boulder [*Univ. Colo. Studies*, Vol. II, p. 101], but the specimen is not now to be found and it is believed to be a case of mistaken identity. We are not aware of its occurrence anywhere else and it is not common at Fossil Ridge.

Anchura americana E. and S.

We obtained two specimens at Fossil Ridge, two above the Hygiene sandstone at the brick kiln east of University Campus, Boulder, and one at the same horizon above the Hygiene four miles north of Boulder, In the Denver Basin monograph it is credited to the middle Pierre and lower Fox Hills. In the upper Missouri region it is found in strata containing a blending of Pierre and Fox Hills species (Meek).

Fasciolaria? sp.

Casts belonging apparently to this genus have been found at Fossil Ridge from five to seven miles south of Ft. Collins. A small example of *F. culbertsoni*, usually considered a Fox Hills species, was found below Hygiene sandstone southwest of Berthoud.

Volutoderma n. sp.

The only locality in which we have found this species is Fossil Ridge, seven miles south of Ft. Collins, and only two specimens found there.

Haminea? sp.

Where Fossil Creek crosses Fossil Ridge we found a specimen somewhat doubtfully referred to this genus and specifically undetermined. It has the appearance of *H. subcylindrica* M. and H.

Anisomyon borealis Morton

A few found at Fossil Ridge. It is reported from a horizon somewhat above the Hygiene sandstone north of Boulder (Stanton), and from the base of the Pierre in the upper Missouri region (Meek).

Anisomyon centrale Meek

We found eight or ten on Fossil Ridge. It is not clear from the literature just what horizon it occupies in other localities.

Anisomyon patelliformis M. and H.

We have found a dozen at Fossil Ridge, none exceeding an inch in length. There is some doubt as to the validity of some of the nominal western species closely related to this one. With our specimens the narrower outline and more nearly central apex of the juveniles, as indicated by the lines of growth and by one immature specimen, point to *subovatus*, but in the angle of apical convergence and small size they are as *patelliformis*. On the Yellowstone river it is found in strata containing a blending of upper Pierre and Fox Hills species (Meek).

CEPHALOPODA

Nautilus dekayi Morton

We found one specimen at Fossil Ridge and Professor D. W. Spangler has presented another from the same place. We also have one from above the Hygiene sandstone three

miles north of Boulder. In the Arkansas Valley it is reported from about the same horizon, but the Denver Basin monograph credits it to the upper Pierre, where it is also found on the Yellowstone River (Meek).

Ptychoceras sp.

We found one example at Fossil Ridge, undeterminable specifically. From three to eight miles north of Boulder *P. crassum* White and *P. mortoni* M. and H. are found just above the Hygiene sandstone.

Baculites ovatus Say

Of this species, which is abundant from Boulder to the Little Thompson above, below and in the Hygiene sandstone, we have found but three or four examples, yet curiously enough Dr. White reported this species from Fossil Ridge and omitted *B. compressus* Say, which is abundant there. The species ranges through the Pierre and into the Fox Hills.

Baculites compressus Say

Abundant at Fossil Ridge, but rather uncommon in the Boulder District, where, however, it has been found both above and below the Hygiene sandstone.

Scaphites nodosus Owen

Found occasionally in the Hygiene sandstone from the south end of Lake Loveland to Rocky Ridge. In the Boulder District it is found both above and below that sandstone. In the Denver Basin monograph it is credited to the lower Fox Hills. On Yellowstone River it is found in upper Pierre (Meek).

Scaphites nicolletii Morton

We have collected four specimens on Fossil Ridge, the only ones we have seen in the state. It is reported from the Fox Hills formation on the Yellowstone River, etc. (Meek).

Placenticeras whitfieldi Hyatt

This large species is common on Fossil Ridge, but is usually found in fragments. In Dr. White's list on page 177 of his report it is given as "*Placenticeras placenta* var. DeKay sp.," but in the text of the same report at page 186 "*Placenticeras lenticulare* Owen sp." is mentioned from the same place, doubtless referring to *whitfieldi*, which he could hardly have overlooked. A large number were found above the Hygiene sandstone three miles north of Boulder.

Placenticeras intercalare M. and H.

We have but one example from Fossil Ridge—a small one. We also have one from the base of the upper third of the Pierre three miles north of Boulder, one from the very top of the Pierre (as its limits are understood in northeastern Colorado) at the mouth of the St. Vrain, and one from the upper Fox Hills four miles southeast of Windsor, all only a few inches in diameter.

PISCES

Lamna sp.

We have a single shark tooth, specifically undeterminable, from Fossil Ridge.

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THE POPULATION OF COLORADO

By John Burton Phillips

Colorado was organized as a territory February 28, 1861. In the summer of 1860 preceding, the census had been taken by United States enumerators and, for the district which was given a territorial organization at the above date, showed a population of 34,277 souls. On August 1, 1876, the territory was admitted as a state. In the following pages some observations are made on the variations of the population since 1860 as to age, sex, nativity, and occupation.

INCREASE

Population of Colorado at Census Years and Percentage of Increase*

Year	Population	Percentage of Increase
1850	None reported	....
1860	34,277	....
1870	39,864	16.5
1880	194,327	387.5
1890	412,198	112.1
1900	539,700	80.7

* *Census*, 1900, Population, Pt. I, p. xxiii.

This table shows that the greatest increase in the population of Colorado occurred in 1859 and 1860 and again in the decade from 1870 to 1880. This is explained by the mining activity at these times. The percentage of increase fell greatly after 1890, due to the severe depression which characterized the earlier years of that decade.

AGE

Percentage of Breadwinners in Population of All Ages*

	1870	1880	1890	1900
United States	32.4	34.7	37.2	38.3
North Atlantic Division	33.34	36.6	40.2	40.8
South Atlantic Division	34.1	35.2	37.0	38.3
North Central Division	30.0	32.4	34.9	36.4
South Central Division	32.6	33.9	35.5	37.0
Western Division	41.6	42.8	44.3	41.6
Colorado	44.1	52.1	46.7	40.4

* *Census*, 1900, Supplementary Analysis, p. 458.

The above table shows the large number of persons among the population of the West and especially in Colorado of middle and younger ages as persons of such ages constitute the element engaged in gainful occupations. The decline in the percentage for Colorado from 1890 to 1900 is probably due to the increase in the number of children and also to the popularity of Colorado as a health resort and tourist attraction.

Age distribution is further shown by the fact that of the United States Colorado ranks third in percentage of population from 40 to 49 years, being exceeded only by California and Nevada; fourth in percentage of population 30 to 39 years, being exceeded by Montana, Wyoming and Washington, and sixth in percentage of population from 15 to 59 years, being exceeded by District of Columbia, Montana, Wyoming, Nevada and California.[1] The large percentage of the population in the productive ages is somewhat striking when compared with that of the other divisions of the United States as appears from the following table.

POPULATION OF PRODUCTIVE AGES. 1900*

PERCENTAGE OF POPULATION, 15 TO 59 YEARS INCLUSIVE

United States.	59.1
North Atlantic Division . . .	62.6
South Atlantic Division . . .	55.3
North Central Division . . .	59.5
South Central Division . . .	54.7
Western Division	63.3
Colorado	65.0

* *Census*, 1900, Supplementary Analysis, p. 152.

EXCESS OF MALES 21 YEARS OF AGE

MALE POPULATION OF COLORADO, 21 YEARS OF AGE AND OVER

Year	Males	Males 21 and Over	Percentage of Males 21 and Over
1860.....	32,691*	31,166	95.3
1870.....	24,820	16,294	65.6
1880.....	129,131	93,608	72.5
1890.....	245,247	164,920	67.2
1900.....	295,322	185,708	62.9
United States, 1900.....	39,059,242	21,329,819	54.6

* 20 years and over. Census does not give number above 21.

This table shows the excess of the population, 21 years of age and over, in Colorado and also the variations in this excess according to the

[1] *Census*, 1900, Supplementary Analysis, pp. 153, 161.

rise and fall of prosperity in the state. The table also shows that there still exists in the state a very considerable excess in the proportion of this element of the population over that prevailing in the United States generally. This disproportion was of course greater in the former decades of the state's history. The population of Colorado has contained a smaller proportion of children and aged persons than the normal population. Young men of voting age have furnished the active element in the development of the state. This appears from the table on p. 204, showing the ages of the population in 1860 and from the following table showing the average number of persons to each potential voter in 1900:

RATIO OF POTENTIAL VOTERS TO TOTAL POPULATION*

States and Territories	Total Persons	Potential Voters	Average Number of Persons to Each Potential Voter
United States	76,303,387	21,329,819	3.6
North Atlantic Division	21,046,695	6,265,767	3.4
South Atlantic Division	10,443,480	2,496,785	4.2
North Central Division	26,333,004	7,545,629	3.5
South Central Division	14,080,047	3,378,514	4.2
Western Division	4,091,349	1,447,604	2.8
Colorado	539,700	185,708	2.9
Massachusetts	2,805,346	843,465	3.3
New York	7,268,894	2,184,965	3.3
Ohio	4,157,545	1,212,223	3.4
Utah	276,749	67,172	4.1

* *Census*, 1900, Population, Vol. I, Pt. I, p. ccii.

A population with so large a percentage of men in the earlier years of life is exceptionally active and well fitted to develop the resources of a new state. People on the frontier represent that period of life when physical vigor is at its maximum, they are energetic, entertain bold conceptions, believe thoroughly in the future possibilities of their state and have always been able through their representatives in Congress to exercise an influence quite out of proportion to their numbers in determining the national policy.[1]

[1] The following resolutions of the Denver City Council illustrate the hopefulness characteristic of the early population of Colorado:

REMOVAL OF THE CAPITAL

At the meeting of the city council on the third inst. the following resolutions were passed:

WHEREAS, The time has arrived when the growth and expansion of the American people in their geo-

SEX

MALE AND FEMALE POPULATION OF COLORADO WITH PERCENTAGE OF INCREASE OF EACH, 1860 TO 1900*

Year	Males	Females	Percentage Increase of Males	Percentage Increase of Females
1860	32,961	1,586	.....	.....
1870	24,820	15,044	24.08†	848.55
1880	129,131	65,196	420.27	333.37
1890	245,247	166,951	89.92	156.08
1900	295,332	244,368	20.2	45.9

* *Census*, 1890, Population, Pt. I, p. lxxvii; *ibid.*, 1900, p. xcii.
† Decrease.

PROPORTIONS OF THE SEXES IN COLORADO, 1860 TO 1900*

Year	Percentage Male	Percentage Female	Females to 100,000 Males
1860	95.37	4.63	4,851
1870	62.26	37.74	60,612
1880	66.45	33.55	50,488
1890	59.50	40.50	68,148
1900	54.72	45.28	82,743

* *Census*, 1890, Population, Pt. I, p. lxii.

The most striking feature in a study of the proportions of the sexes in Colorado is the disproportionate number of females in the population. This was more pronounced in the earlier decades, but is still considerable. This lack of females is of course due to the conditions under which the state was settled, and the attractions which brought men to it. The state was far distant from the homes of most of the early immigrants and was for the first years a collection of mining camps, not places where men were anxious to rear their families.

During the first decade, the number of males decreased 24.08 per cent. while the number of females increased 848.55 per cent. Some

graphical area, population and power have obtained continental dimensions, and render necessary the permanent and equitable location of the federal government, Therefore,

Resolved, by the council of the City of Denver, that we desire and recommend that the present federal district be forthwith vacated, and the same be fixed at the geographical center.

2. That such geographical center is at the junction of the Republican and Smoky Hill rivers, at a latitude 39° North; longitude 20° West of Washington, and 97° West of Greenwich.

3. That if it shall be acceptable to the American people to do so, we invite them to select the city of Denver for such permanent location of the federal capital and government.—*Daily Colorado Tribune*, March 18, 1870.

See also GILPIN, *The Mission of the North American People.* This book, written by the first governor of Colorado territory, and published in 1860, predicts that the metropolis of the United States will ultimately be located in the vicinity of the fortieth parallel of north latitude and the Rocky Mountains.

of this decline of 8,141 in the male population was composed of disappointed miners who returned to the East. These must have met the women going to Colorado. If they did, they did not dissuade them as there were 13,458 more females in the territory in 1870 than in 1860. These cross-currents of immigration and emigration may be explained on the assumption that the early adventurers who decided to remain in Colorado sent back East for their wives.

The immigration which had taken place by 1880 again reduced the proportion of females. The mining development is largely responsible for this change. Since 1880 the percentage of females has steadily increased until in 1900 it had become 45.20 for the state and 50.25 for the City of Denver. This change is in some degree explained by the greater opportunities for women in the lighter employments, consequent upon the development of Colorado as a health resort and tourist state. This appears from the table showing the proportion of females engaged in domestic and personal service.

DISTRIBUTION OF THE POPULATION OF COLORADO BY SEX ENGAGED IN DOMESTIC AND PERSONAL SERVICE*

Year	Males Per Cent.	Females Per Cent.
1880.....	85.6	14.4
1890.....	75.0	25.0
1900.....	67.1	32.9

* *Census*, 1900, Occupations, p. cxxiii.

The above table shows a decline in the percentages of males in domestic and personal service from 85.6 in 1880 to 67.1 in 1900, and a corresponding increase in the percentages of females. This is to be explained in part by the greater approach to equality in the number of the sexes in the state since 1880, and also by the greater opportunities that have been opening to men since 1880. The decline in the percentage of men in domestic service is not as rapid in the decade from 1890 to 1900 as in the ten years preceding 1890. This is due to the depression of 1893, which bore so heavily on the industries of the state that for the time being opportunities of the more active sort were cut off.

NATIVITY

NATIVE AND FOREIGN-BORN POPULATION OF COLORADO, 1860–1900

	Native Born	Percentage of Total	Foreign Born	Percentage of Total
1860	31,611	92.22	2,666	7.78
1870	33,265	83.45	6,599	16.55
1880	154,537	79.52	39,790	20.48
1890	328,208	79.62	83,990	20.38
1900	448,545	83.1	91,155	16.9

The above table shows that the percentage of foreign born increased considerably during the decade after 1860, and to a lesser degree from 1870 to 1880. During the next decade the increase of native and foreign born was about the same, so that in 1890 the proportions of these two classes of the total population were almost exactly what they were in 1880. By 1900 the proportion of foreign born had fallen, due perhaps to the great decline of railroad building and the slackening of the demand for unskilled labor in other industries.

The constituent elements of the native-born population of Colorado since 1860 are brought out by the table on the opposite page. It appears that at each census the persons born in other states and residing in Colorado have in a general way come from the group of states represented by Ohio, New York, Illinois, Missouri, Indiana, Pennsylvania, Iowa, Kansas and Nebraska. The last two states do not appear as furnishing considerable elements of the population till the censuses of 1890 and 1900. Migration from them to Colorado did not assume very large proportions till some time after 1880. They were themselves objective points of migration during the fifties and sixties.

In connection with the growth of Colorado it is interesting to note the states whose populations were most susceptible to the gold fever. Migration to Colorado began at the outbreak of this fever consequent upon the gold discoveries of 1858–59. Men rushed in great numbers to the Rocky Mountains. The census of 1860 shows the state of birth of the population and it is easy to ascertain the states in which the gold fever found the largest number of victims. The states affected by the gold craze seem to fall into three groups according to the degree in which men migrated to Colorado. Placed in the order of their rank, the states

NATIVITY OF THE POPULATION OF COLORADO BY STATE OR TERRITORY OF BIRTH AT EACH CENSUS, 1860 TO 1900. STATES REPRESENTED BY COMPARATIVELY FEW INDIVIDUALS ARE OMITTED

	1860*	1870†	1880‡	1890§	1900**
Ohio	4,125	2,057	11,759	23,806	24,824
New York	3,942	2,778	15,593	23,964	22,320
Illinois	3,620	1,812	12,993	28,196	33,824
Missouri	3,312	1,704	12,435	21,952	31,188
Indiana	2,587	808	5,231	12,596	14,535
Kentucky	1,861	722	3,786	6,049	7,146
Pennsylvania	1,405	1,552	11,387	20,005	19,734
Massachusetts	1,400	621	3,638	5,099	4,589
Wisconsin	1,204	634	3,910	7,051	8,874
Connecticut	980	210	1,226	1,889	1,641
Virginia	868	520	2,441	3,679	3,701
Tennessee	813	297	1,961	3,920	4,225
Michigan	806	528	3,654	6,844	8,094
Iowa	797	1,310	7,520	20,008	24,960
Maine	611	362	2,619	3,192	2,847
Maryland	461	199	1,047	1,815	1,878
Georgia	389	258	918	1,501	1,775
Vermont	375	370	1,568	2,378	2,057
Arkansas	264	90	760	1,315	1,940
Kansas	197	269	4,011	13,265	20,864
New Jersey	143	177	1,479	2,299	2,517
Minnesota	132	77	816	1,952	2,742
North Carolina	130	200	846	1,532	1,848
Nebraska	....	184	932	5,661	11,681
New Hampshire	....	139	737	1,072	909
Texas	....	137	1,043	2,035	3,521
Colorado	....	6,277	26,363	79,486	151,681
New Mexico	....	8,235	9,501	9,331	10,222
Alabama	....	.....	452	970	1,258
California	....	.....	555	1,155	1,929
Delaware	....	.....	232	381	346
West Virginia	....	.....	417	1,290	1,827
Mississippi	....	.....	527	872	1,048
Louisiana	....	.....	416	910	743
Rhode Island	....	.....	368	568	536
South Carolina	....	.....	203	357	470
Utah	....	.....	241	1,124	2,206
Wyoming	....	.....	234	490	1,325
Oregon	....	.....	81	541	467
District of Columbia	....	.....	159	271	334

* *Census*, 1860, Population, p. 549.
† *Ibid.*, 1870, p. 329.
‡ *Ibid.*, 1880, p. 480.
§ *Census*, 1890, Population, Pt. I, p. cxiv.
** *Ibid.*, 1900, p. cxliv.

in the first group are: Ohio, New York, Illinois, Missouri and Indiana. Each of these states furnished native immigrants exceeding 2,500 in number, while Ohio sent more than 4,000.

The second group of states is composed of Kentucky, Pennsylvania, Massachusetts and Wisconsin, and the number of men who came from these varies between 1,861 from Kentucky and 1,204 from Wisconsin. The third group contains the other states and at the head of the list is Connecticut with 980 of its native born in Colorado in 1860.

Some explanation of the difference in the number of native immigrants furnished by the various states may be found by a consideration of the ages of these immigrants and an examination of the conditions of their native states three decades earlier as well as the character of the ancestors from which they sprang. The following table shows the population of the territory of Colorado distributed according to age:

POPULATION OF COLORADO, 1860, DISTRIBUTED BY AGE GROUPS*

	Number	Percentage of Total of Known Age
Under 1 year	49	0.15
1 and under 5	406	1.3
5 " " 10	315	0.9
10 " " 15	298	0.9
15 " " 20	915	2.7
20 " " 30	18,143	53.8
30 " " 40	10,806	32.0
40 " " 50	2,210	6.5
60 " " 70	409	1.37
70 " " 80	7	
80 " " 90	3	
90 " " 100	1	
Unknown	533	
Total	34,277	

* *Census*, 1860, Population, p. 547.

From this table it appears that 28,949, or 85.8 per cent. of the 33,744 persons of known age in the territory in 1860, were under 40 years of age, and 18,143 of these, or 53.8 per cent. of the total, were between 20 and 30; and 915, or 2.7 per cent. of all, were between 15 and 20. The movement of population, therefore, was primarily a movement of young men, men born in the period of which 1830 may be said to be the central year.

It will be seen that the group of states each of which furnished more than 2,500 native immigrants is composed of states which were being rapidly settled in the period from 1820 to 1840. Western New York was comparatively new till after the opening of the Erie Canal in 1825.

During the decade following the opening of this thoroughfare, Ohio, Indiana, Illinois, and Missouri were rapidly filling with population. These were then the "booming" states settled by restless young men and women who had migrated from their birthplaces in the older states farther east. In 1830 the population of the region represented by these states was much like that of Colorado in 1860. When in the latter year the gold fever raged in the country, the children of these restless "boomers" of the 1830 period were the first to be seized with it and they accordingly hastened to the Rocky Mountain region. They were the true children of parents whose restless spirits two or three decades earlier had likewise sent them forth in search of fortune in the undeveloped resources of the West.

In the second group of states are found Kentucky, Pennsylvania, and Massachusetts. These are older states and with the exception of parts of Pennsylvania had been settled before the "booming" times of 1830. Hence the young men in these states in 1860 were not the children of parents who had migrated there a generation earlier, and accordingly they were more immune to the gold fever.

Wisconsin is in this group of states, having furnished 1,204 persons to the migratory movement to Colorado in 1860. This state was organized as a territory in 1836 and in 1840 had a population of 30,945, largely around Milwaukee and the lead mining districts in the southwestern part. This population had settled there after 1830 as according to the census no one save Indians was in the territory at that time. Of the children born to this population between the settlement of the territory and 1840, 1,204 went to Colorado in the gold rush of 1860. In 1840 the populations of the other states of this group, Kentucky, Massachusetts and Pennsylvania were respectively 779,828, 737,699 and 1,724,033. Yet the children of the 30,945 pioneering settlers in Wisconsin went in about the same numbers to the mountains of Colorado in 1860 as did the children of the settlers of Massachusetts and Pennsylvania, states whose populations in 1840 exceeded that of Wisconsin by more than twenty and fifty fold respectively. It is true Kentucky sent considerably more native immigrants to Colorado, than Wisconsin, but this does not injure the comparison when the differences in population are considered. This

again illustrates the tendency of the descendants of pioneers to move on in search of fortune in the undeveloped West.

The third group of states is comparatively unimportant as far as the number of native immigrants is concerned. These states furnished about a fifth of the population of Colorado in 1860. One of the interesting things shown by this group is the small number of native immigrants from territory contiguous to Colorado. The small number from the southern states is also noticeable. In a general way, this group of states taken with the two other groups shows the movement of population to Colorado in 1860 to have been in considerable degree a movement from points many of which may be considered far east rather than a movement of the western people still farther west.

Attention has been called to the small number of early immigrants from Kansas and Nebraska and it may be further explained that these states were at that time sparsely populated, and the slavery struggle in Kansas, which had lasted for a number of years, had occupied the surplus energies of the population and was merging into that of the war at the time of the gold excitement in Colorado. Then it should also be noted that the inducement that first brought settlers to Colorado was the hope of finding gold, and this would appeal more strongly to the population of the entire area of the eastern section than the opening of territory whose chief inducement to the settler was cheap land.

The staying qualities of the various native immigrants to Colorado is illustrated by the figures of 1870. By that time the mining fever had run off and the population had turned to agriculture, stock raising and herding and other occupations. The disappointed miners had in considerable numbers gone away. There were 8,141 fewer males in the territory than in 1860. The number of females leaving at this time cannot be ascertained as there were more females in the state in 1870 than in 1860. Of persons born in Colorado before 1870, 1,235 were reported in that year as living in other states and territories, and as nearly all of these were children, it is highly probable that a goodly number of women had also left the territory during the decade, 1860 to 1870.[1]

[1] *Census*, 1900, Special Reports, p. 309.

The states showing the greatest decline in representation in the territory during this period are the following: Ohio (2,068); Illinois (1,808); Indiana (1,779); Missouri (1,608); New York (1,164). The states which compose the first group lost heavily in numbers at the census of 1870, and the percentages of loss are much the same in the various groups. The states whose native immigrants to Colorado amounted to considerable numbers which had not declined at the census of 1870 are: Pennsylvania, represented by 1,405 in 1860, 1,552 in 1870, and Iowa, 797 in 1860, 1,310 in 1870.

The decade from 1870 to 1880 again shows a large increase in the population, native immigrants coming in great numbers from all the states. The Leadville strikes had been made in 1877, agriculture was developing, 1,400 miles of railroad had been built, the state had been admitted to the Union in 1876 and was generally prosperous. The most noticeable change in the groups of states furnishing the largest numbers of native immigrants is the rapid increase in migration from Iowa, 1,310 in 1870 to 7,520 in 1880, and Kansas, 269 in 1870 to 4,011 in 1880.

The decade following 1880 was a period of unrivaled prosperity for the state. Native immigrants from the various states increased rapidly, Iowa and Kansas taking rank with Ohio, Illinois, New York, Missouri, Indiana and Pennsylvania as the states furnishing the greatest numbers. A characteristic of the growth during this decade was a more even development. More machinery was used in mining and fewer persons were engaged in this industry in 1890 than in 1880. Judged by the number of workers, manufactures had increased 200 per cent. and agriculture in almost the same proportion. Eleven new agricultural counties had been organized in the eastern part of the state.[1]

The decade from 1890 to 1900 was characterized by the panic of 1893, the fall in the price of silver and the depression which lasted until 1896 or 1897. It is accordingly a period when migration from other states was considerably checked. The number of persons in Colorado born in New York, Pennsylvania, Massachusetts, Connecticut, Maine and Vermont was less in 1900 than in 1890.[2] This phenomenon is hard

[1] PAXSON, "County Boundaries of Colorado," *University of Colorado Studies*, Vol. III, No. 4, August, 1906.

[2] An emigration from the eastern counties also occurred at this time.

to explain. It may be in part accounted for by the decline in the non-industrial temporary residents who were forced to return to the East on account of the hard times.

The states from which native immigrants continued to come regardless of the hard times were Kansas, Missouri, Iowa, Illinois, Nebraska. Great increases in native immigration from each of these states occurred, especially Missouri, from 21,952 in 1890 to 31,188 in 1900. From the fact that the stream of migration from Nebraska, Kansas and Iowa to Colorado has steadily increased since its beginning and has apparently been little if at all affected by the vicissitudes that have reduced the migration from other states, it appears that migration from contiguous or near contiguous territory is either of a more substantial character or goes into the industries less likely to be affected by depressions. Iowa, Kansas and Nebraska are agriculture states and it may be that native immigrants from these states are the persons who developed the agricultural resources of Colorado which show such a steady growth. It may also be that the great increase of native immigration from Kansas and Nebraska during the period following 1880 is in some degree explained by the fact that the children of the pioneer settlers of these states had then reached maturity and followed the ancestral impulse to move west.

The nativity of the foreign born that have come to Colorado since 1860 is shown by the table opposite. Canadians, Irish, Germans and English predominated, during the mining immigration of 1860. The Irish, English and Germans increased considerably, and in 1870 there were of each 1,685, 1,358 and 1,456 respectively, while the other nationalities remained few in number. The gold excitement just preceding 1880 again brought up the number of the foreign born, the three nationalities mentioned above considerably leading the others in numbers. A beginning was made during this decade in the immigration from Italy, Russia, Austria and China. By 1890, there is a great increase of the foreign born generally, to the leading nationalities already mentioned being added Sweden, Italy and Austria. It appears that immigrants from these three countries increased rapidly from 1880 to 1890: Sweden, from 2,172 to 9,659; Italy, from 335 to 3,882; Austria, from 453 to 2,700. The increase in foreign immigration during this decade is to be ex-

plained by the great demand for manual labor caused by the enormous material development. The following table shows the railroad building of the state by decades.

NATIVITY OF FOREIGN BORN IN COLORADO, 1860–1900, BY PRINCIPAL COUNTRIES

Countries	1860*	1870†	1880‡	1890§	1900**
British America	684	664	5,785	9,142	8,837
Ireland	624	1,685	8,263	12,352	10,132
England	352	1,358	8,797	14,406	13,575
Scotland	120	188	1,673	4,339	4,069
France	103	209	825	1,328	1,162
Germany	576	1,456	7,012	15,151	14,606
Wales	38	165	1,212	2,082	1,955
Sweden	27	180	2,172	9,659	10,765
Mexico	25	126	186	607	274
Switzerland	25	140	551	1,255	14,79
Holland	16	17	115	192	260
Denmark	16	77	507	1,650	2,050
Norway	12	40	354	893	1,149
Italy	...	16	335	3,882	6,818
Poland	...	49	154	272	465
Russia	...	10	278	1,306	2,938
Austria	...	....	453	2,700	6,024
China	...	....	601	1,447	581
Hungary	...	....	....	359	574
Bohemia	...	....	....	212	330
Belgium	...	....	....	136	170
Spain	...	....	....	50	41
Portugal	...	....	....	28	28
Greece	...	....	....	27	37
Japan	...	....	....	13	51

* *Census*, 1860, Population, p. 549.
† *Ibid.*, 1870, p. 338.
‡ *Ibid.*, 1880, p. 492.
§ *Census*, 1890, Population, Pt. I, p. 608.
** *Ibid.*, 1900, p. 732.

MILES OF RAILROAD IN OPERATION IN COLORADO BY DECADES*

1860	0
1870	157
1880	1,570
1890	4,291
1900	4,649

* *Statistical Atlas of the United States*, 1905, p. 551.

Between 1880 and 1890, 2,721 miles of railroad were built, great mining development was in progress and building in cities was proceeding rapidly. During this period Denver increased in population from 35,629 to 106,713 and Pueblo from 3,217 to 24,558. There was general opportunity for work and therefore an encouragement to foreign immigration.

The decade from 1890 to 1900 is marked by a decline in the number of foreign born from Canada, Ireland, England, Scotland, France and Germany. The chief nationalities which increased during this period are Italy, from 3,882 to 6,818; Sweden, from 9,659 to 10,765; Russia, from 1,306; to 2,938; and Austria, from 2,700 to 6,024. The increase of these peoples, except perhaps that of Sweden, is in part due to their having gone so largely into coal mining. They seem to have become a large proportion of the laborers in this industry.

MINING

The table on the opposite page shows clearly the progress of the state from a collection of mining camps to a great commonwealth of many and varied interests. The column for 1860 exhibits the intensity of the gold fever which had come on the year before and was then at its height, 22,086 persons were engaged in mining. But the surface workings were soon exhausted and at the time the next census was taken, 1870, but 2,200 men were engaged in this industry. The number actually working was much smaller than 2,200. The figures given in the table are those taken from the population schedules of the census and these schedules are made up from the testimony of the individual about whom the information is sought. While, therefore, 2,200 persons told the enumerator in 1870 that they were miners, the census schedule showing the condition of industry and wealth in the territory during that year, which was compiled from data obtained by investigation of the factories and mines, shows but 575 miners employed in the entire territory.[1] This, however, does not include prospectors. It is probable that a large number of miners were at that time out of employment.

A great emigration from the territory had taken place between 1860 and 1870. Some writers have estimated that 100,000 persons were in Colorado shortly after 1860. However, it was soon found that mining required capital, patience and industry, and hence it was that the adventurers, equipped with none of these essentials, turned their faces homeward.

Some account of the characteristics of these early adventurers is found in the descriptions of Colorado in the decade following 1860. In

[1] *Census*, 1870, Industry and Wealth, p. 760.

OCCUPATIONS

POPULATION OF COLORADO, DISTRIBUTED BY OCCUPATION AT EACH CENSUS, 1860 TO 1900. OCCUPATIONS REPRESENTED BY FEW INDIVIDUALS ARE OMITTED

	1860	1870	1880	1890	1900
Miners	22,086*	2,200†	28,970‡	20,067§	28,347**
Laborers	594	1,931	12,902	20,662	17,926
Carpenters	542	552	3,773	8,106	5,592
Teamsters	435	715	2,562	5,806	6,060
Merchants and Traders	651	682	3,565	6,163	7,942
Agriculture	195	6,462	13,462	36,134	43,145
Saloonkeepers	175	175	1,077	1,265	1,291
Blacksmiths	163	232	1,295	2,137	2,390
Butchers	130	79	665	1,126	967
Physicians	116	70	570	966	1,485
Innkeepers	115	281	496	673	609
Mechanics	114	128	615	1,388	2,033
Civil and Mechanical Engrs.	113	115	273	1,085	1,036
Servants	110	357	2,575	10,669	10,253
Clerks	104	263	2,846	6,876	3,981
Painters	29	53	708	1,946	1,662
Brick and Stone Masons	36	114	924	2,726	1,390
R. R. Employees	.....	962	3,364	7,921	8,027
Saw & Planing Mill Employees	.....	143	407	534	711
Ministers	.....	11	234	596	874
Government Employees	.....	113	734	1,034	1,083
Wage-Earners Engaged in Manufacturing	.....	876	5,074	15,016	24,725
Boot and Shoe Makers	.....	.....	470	341	640
Iron and Steel	.....	.....	177	1,042	1,475
Lawyers	.....	.....	807	1,266	1,633
Stockraisers, Herders, etc	.....	.....	4,068	5,247	4,835
Tailors, Dressmakers, Milliners	.....	.....	1,439	3,133	3,429
Brick and Tile Makers	.....	.....	638	1,724	448
Engineers (not civil or locomotive)	.....	.....	1,078	1,785	3,150
Printers	.....	.....	613	1,178	1,359
Street Railway Employees	.....	.....	.....	408	648
Tinware and Tins	.....	.....	.....	441	314
Metal Workers (not iron and steel)	.....	.....	.....	612	2,960
Harness and Saddle	.....	.....	.....	410	315
Steam Boiler Makers	.....	.....	.....	228	375
Electricians	.....	.....	.....		502

* *Census*, 1860, Population, p. 548.
† *Ibid.*, 1870, p. 723.
‡ *Ibid.*, 1880, p. 713.
§ *Ibid.*, 1890, Pt. II, p. 307.
** *Ibid.*, 1900, p. 511.

the latter year of this decade the population was estimated at about 50,000 or 60,000, one-fourth Mexican in southern section, ignorant and debased to a shameful degree. The remainder were said to be as good as in any new state.

But the New England leaven though possibly not the New England personality is dominant in their ambition, their education, their morality, their progressive spirituality. The pioneer miners, the "prospectors," are a class of characters by themselves. Properly they never mine; to dig out and reduce ore is not their vocation; but they discover and open mines and sell them, if they can; at any rate they move on and discover others. Men of intelligence, often cultivated, generally handsome, mostly moral, high toned and gallant by nature, sustained by a faith that seems imperishable, putting their last dollar, their only horse, possibly their best blanket into a hole that invites their hopes, working for wages only to get more means to live while they prospect anew and further, they suffer much and yet enjoy a great deal. Faith is comfort and that is theirs; they will "strike it rich" some day; and then, and not till then, will they go back to the old Ohio, Pennsylvania, or New England homes, and cheer the fading eyes of father and mother and claim the patient, waiting, sad-hearted girls, to whom they pledged their youthful loves. The vicious, the loafers, the gamblers, and the murderers have mostly "moved on;" what is left is chiefly golden material; and the men and the mines and farms of Colorado, all alike and together, are in a healthy .and promising condition, and insure for her a large growth and a generous future. The two things she lacketh now are appreciation at the East and women; what she has of both are excellent, but in short supply; but the Railroad will speedily fill the vacuums.[1]

As the proportion of women was 4.85 to 100 men in 1860, the force of the words "short supply" is at once apparent.

The number engaged in mining did not again equal that of 1860 until after the Leadville strikes shortly preceding 1880. Just previous to that year a large increase of immigration had taken place so that the census reported 28,970 persons in the mining industry. There was the usual number of adventurers who were soon disappointed and returned so that ten years afterward the number in the mining industry was again reduced considerably, there being in that year 20,067 so employed. If the statistics were available for the number of men employed in mining for each year from 1890 to 1900 the first half of this decade would certainly prove a period during which fewer men were so engaged. The closing of the mints to silver in India, and the repeal of the silver purchasing clause of the Sherman act causing an enormous decline in the price of that metal resulted in closing a multitude of silver mines in Colorado and throwing a great many men out of employment. According to a perhaps somewhat exaggerated estimate 45,000 were thrown out of em-

[1] BOWLES, *Our New West*, 1869, p. 195.

ployment in the state, and although these were not all miners a considerable proportion of them was.[1]

The Cripple Creek strikes which were made during this decade again increased the number of men in the mining industry. The energy formerly devoted to silver mining now turned its attention to the extraction of the yellow metal and the census of 1900 shows almost as many engaged in the mining industry as the census of 1880. In that year there were 28,970 while in 1900 the number was 28,347.

It might seem at first thought that a larger number would have gone into mining after the Cripple Creek strikes, especially since the population of the state had so greatly increased. However, this is explained by the changes that had taken place in the character of the industry. The early miners were men with small capital, working placers and generally such workings as could be carried on without the necessity of sinking deep shafts, blasting tunnels, and employing expensive engines and hoisting machinery. But the strikes in Cripple Creek were not of the nature to appeal to this class of miners. The mines there required expensive machinery and large capital. More scientific methods of treatment had been discovered. In short, the industry had become in considerable degree amenable to exact science, and such elements of risk as still remained were in the hands of men capable of playing for large stakes. Hence the impecunious adventurer did not enter the field. It is true that machine methods have somewhat reduced the manual labor in mining, though it will probably always be necessary to depend to a great extent on such labor at the initial stages of ore extraction. But mechanical drilling has proved a successful substitute for handwork to a considerable extent.

AGRICULTURE

MALES ENGAGED IN AGRICULTURE IN COLORADO*

1860	1870	1880	1890	1900
195	6,462	13,462	36,134	43,145
Percentage of Increase.....	3,217.0	108.3	168.4	19.4

* *Census*, 1900, "Agriculture," Pt. I, p. lxxix.

[1] *Bulletin of the Bureau of Labor, Colorado*, September, 1893.

NUMBER OF FARMS IN COLORADO*

1870	1880	1890	1900
1,738	4,506	16,389	24,700
Percentage of Increase ..	159.3	263.7	50.7

Ibid.

Agriculture is the most important industry in Colorado, the value of its products being slightly in excess of those of the mines. The progress of this industry is shown by the tables illustrating the number engaged in it and also the number of farms worked with the percentages of increase from decade to decade.

It appears that in 1860 the number of persons engaged in agriculture was negligibly small, but by 1870, 6,462 individuals had found their way to this fundamental pursuit. This increase of agriculturists was to some extent hastened by the disappointment of those who failed to find fortunes in the gold rush of 1859. A number undoubtedly were driven into farming on account of shortage of means with which to again reach the states. Then also, it became known during this decade that irrigation could be used with success, and that there was also a local market for farm produce.

The increase in the number of males engaged in agriculture from 6,462 in 1870 to 13,462 in 1880 is to be accounted for by the opening of the railroads in June and September of 1870, by the demand for supplies at the mines and to support the increase of population which followed the Leadville strikes of 1877, and also by the development of irrigation on a somewhat extensive scale. It was during this period that a number of the Colony Settlements were made. In the period from 1870 to 1873 the colonies of Greeley, Longmont, Fort Collins, Colorado Springs and Evans were established and by 1880 had received large additions. These were made up of efficient farmers selected with considerable care, in the East, and were established at once as agricultural communities and, excepting Colorado Springs, have remained such. The figures for 1890 show an increase of agriculturists from 13,462 in 1880 to 36,134, a gain of 168.4 per cent. while the increase in population of the state was 112.1 per cent.

This represents the period during which alfalfa was introduced. The enormous profits resulting from it stimulated greatly the farming industry. Flouring mills greatly increased at the same time and as a consequence a strong local market was created for wheat. Wheat was formerly not so profitable, as the costs of transportation tended to reduce the price to the seller. But when the milling could be done at home there was an added value. Some idea of the development of agriculture during this period is indicated by the following table.

INCREASE OF PRODUCTION OF CEREALS IN COLORADO*

	1884	1879	Per Acre in U. S.	Per Acre in Colorado
Barley	234,085	107,116	22.02	23.08
Buckwheat	2,688	110	13.93	19.47
Corn	653,694	455,968	28.13	27.80
Oats	1,644,083	640,900	25.26	26.99
Rye	35,882	19,462	10.76	14.22
Wheat	2,220,536	1,425,014	12.97	20.71

* *First Biennial Report of the Bureau of Labor*, 1887, pp. 384–85.

During the decade from 1890 to 1900 the number of males in agriculture increased from 36,134 to 43,145, but the percentage of increase was not as great as in either of the three preceding decades, being but 19.4. This was to be expected owing to the large number already engaged in the industry. Among the other causes of the decline in the rate are the depression in the years following 1890, and the fact that most of the land irrigable at moderate expense had been taken up. It is estimated that the cost of getting water on to land in sufficient quantity to make it valuable for agricultural purposes is from $25.00 to $40.00 an acre. In the earlier days of agriculture in Colorado much land was watered for considerable less per acre, and as time progresses, the expense of watering increases; more expensive canals have to be built to enable water to be placed on the more inaccessible lands. Thus it comes that agriculture requires more capital now than in the earlier decades. This of course, would tend to check the movement of the poorer classes to that occupation.

A glance at the table showing the number of farms would seem to show that they do not tend to increase in size. It appears that the per-

centage of increase in the number of farms has invariably exceeded that of the number of males engaged in agriculture. While this does not prove that farms are not increasing in size, it is a strong indication of it. It may be that the next census will show a lower percentage of increase in number of farms, and a higher percentage of increase in males engaged in agriculture owing to more intensive cultivation. To raise such crops as sugar-beets requires a large number of laborers.

However, if the profits in raising beets continue, there can be no doubt that farms will tend to increase in size. This has always been the rule in all countries. Wherever an industry yields extraordinary profits it ultimately passes into the hands of the wealthy classes. The elimination of the small farmer in England as a consequence of the increased profits of agriculture due to the introduction of the turnip and deep root grasses is a case in point.

MANUFACTURE

The table shows a great increase in the number of persons in this industry. The percentage of the total population engaged in manufacture shows a steady increase since 1870, but the percentage of increase of wage-earners in manufacture shows a continuous decline since the decade from 1870 to 1880. The following table illustrates this:

	1870	1880	1890	1900*
Percentage of total population engaged in manufacture	2.2	2.6	3.6	4.6
Percentage of increase of wage-earners in manufacture	....	479.2	195.9	64.7

* *Census*, 1900, Manufactures, Pt. II, p. 61.

The figures seem to show a great increase in manufacturing between 1870 and 1880. This resulted from the advent of the railroad perhaps to a slight extent, and also from the fact that a great impetus was given to mining by the Leadville developments of the period from 1877 to 1880. There was much demand for iron work in connection with mining, and much of this work was of necessity of a local character. This is shown by the increase of mechanics from 128 to 615 and blacksmiths from 232 to 1,295. Engineers exceeded 1,000 in 1880, and wage-earners in manu-

facture increased from 876 in 1870 to 5,074. The increase of wage-earners to 15,016 in 1890 and to 24,725 in 1900, and of engineers from 1,785 in 1890 to 3,150 in 1900 is evidence that considerable progress in manufacture occurred during the next two decades, though the rate of increase of wage-earners in the industry fell from 195.9 per cent. for the decade from 1880 to 1890 to 64.7 for the succeeding decade. This is in part due to the size of the industry and in part to the depression of 1893, that depression having dealt manufacturers such a severe blow that in some parts of the state, the industry had not recovered by 1900. This was the case in Denver where the value of manufactured products was less in 1900 than for the year 1890.[1]

Among the interesting things shown in the table is the decline in the number of workers in various industries between 1890 and 1900. There were 2,514 fewer carpenters in 1900 than ten years previous. This is largely explained by the decline which followed the phenomenal amount of building that occurred in 1890. That there was a considerable slump in building trades during the decade is further shown by the decline in the number of brick and tile makers from 1,724 in 1890 to 448 in 1900. Brick and stone masons also declined from 2,726 to 1,390. The number of painters was reduced from 1,946 to 1,662 during the same period. So likewise the harness and saddle workers and those in tinware and tin both suffered a reduction in numbers between 1890 and 1900. The number of merchants and traders had increased somewhat, though not so much as the numbers in some other lines of activity. Taken with the decline in the number of clerks from 6,876 to 3,981, it is difficult to understand just what changes were at this time occurring in the mercantile industry.

From this study of the constituent elements of the population of Colorado some light is thrown on the development of manufactures in the state. Manufacturing development has proceeded slowly on account of the lack of aptitude in the population for this line of activity. This lack of inclination toward manufacture which has been characteristic of the population has resulted from two chief causes, heredity and environment.

[1] *Ibid.*, p. 65.

It has been shown in the discussion of nativity in the preceding pages that in the main the early population of the state was composed of the children of a restless class of pioneers who, inheriting the spirit of their fathers, left their homes in the older states and sought their fortunes in the then frontier states of the West. Vigorous, aggressive and discontented with the steady habits and small returns of industry in their native states, they felt themselves impelled to move on and subdue the region of the Ohio Valley. This they did, rearing meanwhile a generation inheriting their own restless natures and like themselves imbued with an aggressive and adventurous spirit seeking a larger field of activity. These early came in great numbers to Colorado. Later on came similar children of the pioneers who had settled Iowa, Kansas and Nebraska. Thus it comes that the most active element of the population of Colorado has always been represented by the children or the pioneers of the states of the Middle West. When the children of the pioneers of Colorado reached maturity, there was no longer the opportunity to move west with the prospect of fortune within a short period. A large proportion of the children of these pioneers has therefore remained in the state, and, inheriting the spirit of three or four generations of aggressive and adventurous settlers, is apt to prefer mining and speculative enterprises to manufacturing industry with its steadier and smaller returns.

The environment of those persons that have grown to maturity in Colorado has also been such as to keep alive the love of activity and achievement inherited from their pioneer forebears and has tended in some degree to unfit them for manufacturing industry.

From the rise and fall of prosperity in the mining industry shown by the above table of persons engaged therein, some idea of the effect on the development of that attitude of mind in the population which fits it to undertake and continue routine industry may be gained. Variations in one industry which at various times seem to hold up before the persons engaged in other industries whose return is more steady, the possibility of sudden wealth, tend to retard the healthful growth of those fundamental activities which are necessary to supply the everyday needs of a population. A people constantly tempted by rich mining strikes to leave their farms, counters, and workshops and seek their fortunes in

the hidden treasures of the mountains does not develop that patience and contentment necessary to him whose industry will yield but small returns.

Colorado began her life in the first flushes of a gold fever. By 1870 depression was on in the territory, and great numbers returned to the East. In the late seventies another mining fever and another rush to the mountains. In the period following 1890 another depression more severe than any that had gone before; but soon followed by rich strikes in the Cripple Creek district. A population exposed to these changes and possibilities does not accustom itself readily to those industries yielding small returns. It has been filled with the notion that somehow it is possible to amass a fortune rapidly. Hence, the enormous amount of energy devoted to finding methods whereby this can be done. While it is true that the allurements of mining do not appeal to the youth of the West at the present time as they did to his father at an earlier day, nevertheless, having been reared in a community where there live a number of men who have "struck it rich," he thinks of large profits and a comparatively few years as the time necessarily needed to amass wealth. He is therefore attracted to speculative undertakings, and not enthusiastic for manufacturing or other enterprises that do not promise speedily a large return.

THE ALLEGED GROWTH OF ALTRUISM IN THE CIVILIZED PERIOD

By Melanchthon F. Libby

In the current number of a scientific journal occur the following sentences:

> Altruism arose chiefly as a kind of enlarged egoism. At first man must have been chiefly, if not wholly, individualistic, but very soon a time came when individualistic selfishness no longer served its egoistic ends, and self-preservation required the extension of each self to embrace all members of the tribe. Self-interest thus became absorbed in tribal interest, not at first because of any moral ideas about the rights of others, but solely because in this way each one's self-interests were better served.

This is one of a number of passages I have been marking for several years in which writers speak of altruism as something which has *arisen* or *developed*, or *expanded*, and usually at the expense of *egoism* or *individualism* or *selfish interests*.

No one of course thinks of speaking of the facts of physical nature in terms analogous to these. Occasionally we hear that *selection* (meaning the biological law, or principle, or statement concerning uniformity in phenomena) can accomplish certain results. But this is so obviously a piece of loose writing that it does little harm. It is not a real hypostatization of the abstract into a spook reality, any more than if a schoolboy should say a weight falls because of "Newton's law." Still even these phrases are opposed to clear reasoning. Now, of course, since the Middle Ages, we do not think of taking abstract nouns for *reals* except in the sense in which everything with content has some degree of reality. If one makes no claim to scientific exactness and is interested rather in mental therapeutics of any sort it may be pardonable for him to speak of the influence of the mind on the body, of the eternal nature of law and virtue, of the beneficent activities of gravitation, etc., but such words add confusion to counsel in a scientific notation. When shall we see a real descriptive ethics kept clear of all normative phraseology? Is it not time that each writer should be frankly, consistently, and con-

sciously either normative or descriptive in his treatment of the problems of individual conduct? If conduct is treated descriptively it is hardly, in the older sense at any rate, under the categories of good and bad: that is to say, the theory of values is precisely the object of investigation and must not be allowed to enter subjectively into the judgments of the investigator. We do not say that a ray of light takes an evil course in passing through a tumbler of water, but only that it takes a deflected course. Any other attitude would be as unscientific, however pleasing and natural, as swearing at the hammer, or the dull carving-knife, or the refractory collar-button. So far as scientific description goes, a human act, such as killing a man, is a resultant of forces which follow the line of least resistance; and, objectionable as this may be to pedagogical or therapeutical ethics, it is a conception absolutely essential to clear reasoning in descriptive ethics. The purely scientific attitude is the best in this subject. The *aesthetic* attitude of enthusiasm for one's material seems harmless. But the *moral attitude* is the worst attitude in which ethics in any scientific sense can be approached.

No one would write such a sentence as the following: Metabolism arose chiefly as a kind of enlarged anabolism: at first man must have been chiefly, if not wholly, anabolic, but very soon a time came when anabolic hoarding no longer served its ends, and a healthy activity required each body to bring itself to bear upon external objects in a cheerful activity. When a physicist speaks of the positive and negative aspects of an electric current he does not conceive them as two separate entities which can as such, and relatively, arise and extend, or decline and contract. He may, of course, say that men are now using electric appliances in a vastly more complicated and extensive manner than ever before. There is no harm in the words anabolism and negative electricity. They are harmless, necessary abstractions without which and their like no academic work could proceed and no scientific control of nature be achieved. The harm is in treating them as spooks from Platonic cloisters of monastic Europe. In the same way, if conduct follows the laws of least resistance, altruism can no more *arise* than metabolism, or positive electricity or repulsion of bodies. It is only the abstraction that can arise and be extended by analysis.

We say that the blood circulates through the body and then for convenience we say it flows *out from* the heart, and *back to* the heart, and these relative terms of direction have a value of their own; but we do not say that the flow of the blood toward the capillaries arose through some defect of the inward flow through the veins. Egoism and altruism are two abstract nouns which we may conveniently use to denote different aspects of the conduct of a man in relation to other men. When the act is regarded as favorable to the other men (under proper definitions of the word favorable) the act is called altruistic; when it is regarded as favorable to the agent the act is spoken of as egoistic.

There is no *inherent probability* that egoism and altruism differ from time to time in amount either in individuals or in nations. Of course there are diseased states of the body in which the circulation is disturbed, but these lead toward the destruction of tissues and in a larger sense to death. And in other analogies a disturbance of equilibrium in active or moving things leads to a change of state, which from some point of valuation may be called destruction or ruin, etc. It is likewise obvious that some men are excessively "egoistic;" but it is not at all obvious that their egoism leaves them fully *alive* and in the enjoyment of a maximum of psychic health and activity. Is it not possible that a cold-blooded scientific ethics would give morality the solution of its time-honored, paradoxical question, "Why should I be unselfish?" It might prove that the answer would be akin to this: I want good arteries because I want a good circulation. It is not altruism nor egoism that men and nations crave, but *life*, and that more abundantly. Altruism was emphasized as a means of giving men life more abundantly. It may have been worshiped as an entity, but richness of life is the real entity, and it may be got, like a good circulation, by relieving congestions and purging of obstacles.

If we look at genetic treatments of altruism we usually, but not quite always, find it treated as something that was created or invented or discovered or originated, by some inspired man or group of men, or as something that arose in very early conditions of society after egoism had failed to make men healthy and happy. But now if we leave out conscious motivation and clear ideas of purpose and character and

sympathy, and treat altruism and egoism simply by their results, that is, treat conduct or individual acts simply by their results, we may say that egoism corresponds to the credit side of the account and altruism to the debit side. The circulation of money is here the reality: the income and expenditure are, relatively, the abstractions. As a financial being a man is *real* when his income and expenditure are equal; only in this case has he the richest financial experience. Debt means or tends to mean bankruptcy, hoarding means or tends to mean loss of experience. In the same way a man or a race is really living when its moral expenditure and income are equal. The race must be regarded as a living race, a going concern. It is not reasonable to say that there was a time when man must have been chiefly, if not wholly, selfish, unless it is meant that there was at that time a great depression of life, a genuine danger of extinction. It does not suffice either to prove that primitive man had few interests and narrow horizons: lions have these and yet they seem to have great intensity of life and circulation.

Some of those who consider conduct genetically, point out that newborn infants are wholly egoistic. If this were true it would carry weight. But is it true? Here surely egoistic is a purely scientific word because infants have absolutely no conscious motives, or "ideas" of purpose and sympathy. Then their acts must be judged by results. Do they not show the altruistic aspect as strongly marked as the egoistic? Each infant is the *Träger* of the family, even, in a sense, of the race. Any failure to take nourishment, an act producing pleasure in the mother, would be a failure toward posterity.

Others appeal to the fierce isolation of the beasts of prey and other animals. It is true that animals have narrow horizons of life. But *within these* what reason is there for believing that altruism and egoism are not equal? Trees and shrubs and flowers have narrow lives, but do they not give out to the air and the earth and to animals and man as much as they receive? Action and reaction may be equal in this pair of terms as others. I spent two hours watching a cage of hyenas in the Berlin zoölogical gardens, and the father spent nearly every minute of that time licking and fondling his ugly, vicious-looking offspring. The male lion spends his time in toil and fight and great danger largely in order to carry his prey to the whelps.

Spencer saw clearly that the great confusion on this subject arises from comparing the altruism of a large circle of interests and sympathies, with the altruism of a small circle of interests and sympathies, instead of comparing the altruism in each circle of interests and sympathies, with the egoism in that same circle. There is no proof and no inherent probability that in healthy individuals, or in healthy races the ratio between them varies more than it varies in physical circuits and circulations between the outgoing and incoming currents. *Indeed, there seems much reason to define life in the moral nature as the equivalence of these factors and to associate any lack of their equivalence with a tendency to a disturbance of life and vigor.*

This view of the whole matter was seen with much clearness by Shaftesbury in his justly celebrated *Characteristics*[1] where he gave a tabulation of the affections which set up the ideal of moral life as a balance between selfishness and benevolence. He sees this not as a modern idea, but as a law of nature, and says that when bitches eat their young they are called "unnatural." He might have added that all who kill the things they love, or ought to love, destroy themselves and their race.

The evolutionists, especially Darwin himself, have often spoken of Shaftesbury with very marked approval.

A modern doctor does a thousand acts of kindness for one done by a primitive savage; but he receives more money, esteem, love and self-respect in an equal proportion. The savage would have murdered a neighboring tribesman at sight (just as the doctor would order a chicken for breakfast, or a roast for dinner, or as even Wordsworth may have killed a troublesome insect), because of a limited circle of interests and sympathies. But the savage loved his offspring to the death, and that is why we are here today, some of us maligning him.

[1] Libby, 'Ethics of Shaftesbury," *Amer. Jour. of Psych.*, September 1901.

SOME LEGAL ASPECTS OF HIGH-SCHOOL FRATERNITIES[1]

By John D. Fleming

The authority of governing boards and faculties of high schools over organizations within such schools known as high-school fraternities has been a question much discussed during the past two or three years, and the fraternities themselves, their influence and tendencies, the subjects of no small concern among parents and educators. It is the purpose of this paper to present some legal aspects of this question, referring at the outset briefly to a few general or basic principles bearing upon the subject and more particularly to the laws of Colorado in relation thereto, and to the adjudged cases.

By the Constitution of Colorado the maintenance of free, public, non-sectarian schools and the gratuitous instruction therein of all children between the ages of six and twenty-one years is forever guaranteed, and the general supervision of such schools is vested in a board of education, whose powers and duties shall be prescribed by law. The superintendent of public instruction, the secretary of state and the attorney-general constitute what may be called the general or state board, and provision is made in another section for the organization of school districts of convenient size and the establishment therein of another board of education consisting of three or more directors, to be elected by the qualified voters of the district, and to these directors is committed the "*control of instruction in the public schools of their respective districts.*"[2]

Observe that in the exercise of its general supervision the powers and duties of the State Board of Education according to the constitution, shall be as subsequently "prescribed by law," that is, by the legislature; while the control of instruction in the public school is vested in the school directors in their respective districts, and that such command over the public schools by such directors is prescribed by the constitution

[1] Revised by the author from a paper read before the Colorado Teachers' Association, January 1, 1908.

[2] *Const. Colo.*, Art. IX §§ 1, 2, 7, 8, 15.

itself, and cannot be divested—even by the legislature or by any other department of government.

In accordance with the authority granted by the constitution the first legislature after Colorado became a state passed laws defining the powers and duties of the State Board of Education, and provided for the ascertainment of school districts and the organization of district schools and of high schools, and prescribing the powers and duties of their governing boards, which laws have remained until the present substantially unchanged. The governing boards of high schools are called in the original act and in the amendatory and supplemental acts passed from time to time, committees, but these committees, whether of "district" or "union" or "county" high schools, are taken in turn from the district directors; and it is a noticeable fact that in this distribution of powers and duties among the various educational boards no attempt has ever been made so far as the writer can ascertain, to derogate from the high-school committees the powers originally granted by the constitution to the district directors, namely, that of the *control of instruction in the public schools.*[1]

The constitutional grant to the school directors is contained in a broad phrase, the control of instruction. In elaborating it the first Colorado legislature gave to all school boards the "power to make such by-laws for their own government and for the government of the public schools under their charge as they may deem expedient," and again, in subsequent sections of the same first legislative act, this control of instruction becomes diffusive and flows through many channels. It is unnecessary to mention them all. But among the enumerated powers we find the following:

> Every school board, unless otherwise especially provided by law, shall have power, and it shall be their duty . . . . to suspend or expel pupils from school, who refuse to obey the rules thereof.[2]

That is the law of Colorado, and has been the law since territorial days. There are no other general or special statutory provisions that I can discover upon the subjects of suspension or expulsion from school;

[1] *Mills Ann. Stat.*, chap. 109.

[2] *Mills Ann. Stat.*, §§ 4012, 4015.

and the absence of such eliminates the phrase "unless otherwise especially provided by law." The only remaining part of the enactment worthy of comment is perhaps that relating to disobedience of the rules.

At common law it was the duty of parents to give their children an education suitable to their station in life.[1] But while the common law recognizes this as a duty of great importance, there was no remedy provided for the child in case this duty was not discharged by the parent; neither was there any punishment inflicted on the parent.[2] Under our scheme of government wherein education is supported by taxation and to a certain extent is compulsory, and enforced by penal provisions,[3] the right of the father to have his child and the right of the child to be admitted and retained in the public school will perhaps be conceded by all. It is a valuable right, and not lightly to be taken away. It is within the constitutional guaranties, and, in the face of the statute, will be protected by the courts.

Those pupils are excluded, says the law, who refuse to obey the rules. What rules? In contested cases of course judicial decisions supply the answer: It is only these rules which under the circumstances of the case are reasonable and within the competency of the school authorities to make, and the infraction of which, moreover, is brought home to the pupil by proof, with notice and opportunity to him to be heard and to defend himself. These things—reasonableness of the rule broken, proof, notice, hearing—are all fair requirements. They would seem to be axiomatic. Yet they have been so often disregarded that courts have had many times to interpose, and to remind those in authority that some things cannot be too well remembered and that failure to observe them or some one of them may be a denial of that fundamental principle as old at least as *Magna Charta* and known as "due process of law;" which means, says Mr. Webster in the celebrated Dartmouth College Case:

> The law of the land—the general law—a law which hears before it condemns, which proceeds upon inquiry and renders judgment only after trial. The meaning

[1] *I Bl. Com.*, 450.

[2] *I Bl. Com.*, 781.

[3] *Mills Ann. Stat.*, §§ 418, 419.

is that every citizen shall hold his life, his liberty, property and immunities under the protection of the general rules which govern society.[1]

Not long ago the public press contained this ultimatum of the Denver School Board to the high-school boys and girls who owe allegiance to the fraternities or sororities of the Denver high school:

All pupils of the Denver high schools who shall become members of a fraternity, sorority, or other similar organization, on a date subsequent to November 8, 1907, shall be continuously denied all the privileges and activities of these high schools except those of the classroom and that of receiving a diploma, immediately after such date of membership.

A similar inhibition according to the same account is put upon those pupils whose membership in such organizations dates from a time prior to November 8, 1907, and who may enter school after September 1, 1908, unless all connection with such organizations shall permanently cease on or before September 1, 1908.

In the State Preparatory School at Boulder (which is practically a high school) yet more drastic action was proposed. In a letter addressed to the parents of the State Preparatory School students, under date of August 29, 1907, the parents were advised that the school board would not admit to the school this year any person who had become an active member of a secret social organization since October 1, 1906, at which time action opposed to secret social organizations was first taken; and the board sought in the letter the earnest co-operation of all parents and patrons of the school.

The action of the Boulder school board resulted in an "understanding," reached September 13, 1907, between the board on the one hand and the fraternities on the other; by which the fraternities stipulate that they have neither initiated nor pledged any new members since September 1, 1907, and that they will not at any time in the future invite, initiate, or pledge new members in their respective societies. They further stipulate that as soon as the present members of the respective organizations have been graduated from the Preparatory School, the fraternities will cease to exist as active organizations in connection with school life of the Preparatory School. The board on their part agree to show no discrimination against the fraternities so long as the stipulations men-

[1] WEBSTER, "*Arguendo*, in Dartmouth College Case," *4 Wheat.*, p. 518; *Black. Const. Law*, p. 481.

tioned are observed, and further, that the members of the fraternities who have joined since October 1, 1906, shall be admitted to all privileges, etc. So far as the writer is advised the agreement has been faithfully kept and performed; and this, all agree, was a happy issue out of the Boulder troubles. The action of the Denver and Boulder school boards is perhaps typical of what has been done or proposed in other localities in the state and country at large. In the one, it is observed, continued adherence to the secret societies debars the student from participation in certain privileges which are incidental to regular school work, such as athletic, military, musical and class organizations; while the other, as the resolution first proposed, prevented admission to the school altogether if such adherence were continued; though happily, as indicated in the Boulder case, the compromise effected obviated any necessity of a resort to the harsher method of denying admission to a student who maintained his former fraternity connection, or who had joined after a certain date.

The question recurs, what is the legal aspect of these examples? That the boards respectively are satisfied with the policy of their action the writer thinks is not open to argument—at least not to this argument; and as to the legality of each there seems to be little doubt, even as to the severer step first contemplated by the Boulder authorities. This conclusion appears to be justified not only in view of the very broad discretionary powers reposed in boards of school directors by the Colorado constitution and legislative enactments, but from consideration also of the adjudicated cases. The Colorado courts of last resort have not passed upon these questions as far as the official reports disclose; neither does the writer know of their having been litigated in any of the tribunals of this state; and but four of such cases have been reported from the higher courts of other states of the Union; and in but two of these are high schools directly affected. Reference first is made to the case of *Wayland* v. *Board of School Directors*, decided by the Supreme Court of the State of Washington in August 1906[1] and the action of the school board in that case is so strikingly similar to that of the Denver board that one cannot escape the conviction that the resolution of the

[1] *86 Pac.*, 642; *7 L. R. A.* (1907), 352.

Denver directors was framed with the Washington case before them. It certainly appears to be a safe precedent to follow. Briefly, George Wayland, a minor eighteen years of age, by his father and guardian, sued the Seattle school board, seeking to enjoin them from depriving the said minor from certain high-school privileges. He alleged that he was of school age and entitled to all school benefits; that he was a member of a certain secret Greek-letter society, and that he was unjustly prohibited, with his fellow members, from belonging to debating clubs, school bands, glee clubs, orchestras, cadet corps and other kindred organizations of said school; that unless they withdrew from said fraternity he and they would also be deprived of the customary honors attending graduation; that they had no privileges except that of attending classes; that the rule so excluding them was in excess of lawful authority; that there was nothing objectionable in said fraternity, their meetings being held at the homes of their parents with consent of such parents and always after school hours, at which meetings all improper conduct was prohibited and a high-class literary programme carried out. From a final judgment refusing injunctive relief in the trial court, an appeal was taken to the Washington supreme court; and there the judgment of the lower court *was affirmed,* all five of the judges concurring.

From the facts of the case it would be hard to discover a state of affairs more "upon all fours," as the lawyers say, with those with which the Denver school board was concerned when it passed its order above quoted. The case, of course, is not of binding authority upon the courts of other states should a similar question arise in them, but the reasoning of the judge who pronounced the opinion is very persuasive, as anyone who reads the official report will perhaps acknolwedge. The trial court had made findings of fact which were not favorable to the society; extracts from its official magazine were quoted, and letters from the Sacramento, Calif., and Denver, Colo., chapters were published, which, together with the testimony of the principal of the school, all tended to show a seditious spirit in the organization, an inclination to snobbish and patronizing airs not only toward other pupils but toward the teachers, and contempt for school authority, and that the members of the society considered their obligation to the fraternity greater than that to the

school; and the appellate court expressed its complete satisfaction with the findings.

It will be perceived that the Washington court did not dismiss the case as being not within its jurisdiction but within the jurisdiction of the school board alone. It entertained the cause to inquire what powers had been legally conferred upon the board and whether the board had arbitrarily exceeded its authority. It gave to the student his "day in court," wherein to avail himself of the "law of the land."

The only other reported case involving Greek-letter fraternities arose in Indiana. It was the case of *Stallard* v. *White*,[1] in which the right of the trustees and faculty of Purdue University (which is the Indiana State Agricultural College) to make membership in a Greek-letter fraternity a disqualification for admission as a student to the university, was denied by the highest court of that state. The applicant who was refused admission because of his refusal to sign a pledge to disconnect himself as an active member from the society during his connection with the university, was held to be entitled to a *mandamus* to compel his admission. In view of this decision it would seem at first blush that the authorities at Boulder were treading upon dangerous ground. But the practical force of the decision, it is submitted, is much weakened by the language of the judge (which is the language of the court) in the course of the opinion.

> The admission of students in a public educational institution is one thing . . . . and the government and control of such students after they are admitted, and have become subject to the jurisdiction of the institution, is quite another thing. . . . . It is clearly within the power of the trustees and of the faculty . . . . absolutely to prohibit any connection between the Greek fraternities and the university. The trustees have also the undoubted authority to prohibit the attendance of students upon the meetings of such Greek fraternities, or from having any other active connection with such organizations, so long as such students remain under control of the university, whenever such attendance upon the meetings of, or other active connection with, such fraternities tends in any material degree to interfere with the proper relations of students to the university.

There was a dissenting opinion, but the decision of the majority of the Indiana court seems to proceed upon the theory that if mere mem-

[1] *82 Ind.*, 278; *42 Am. Rep.*, 496.

bership in a Greek-letter fraternity works a disqualification *for admission* to the university, then membership in any other secret society would be converted into a like disqualification, and discriminations would thereupon ensue against large classes of inhabitants, etc. But it is submitted that it makes little practical difference to a board of education whether they are denied the power to refuse admission to a student to the public schools on the ground that he is a member of a secret society, if it be conceded, as this case seems to concede, that they have the right to expel or suspend such student for attending its meetings or for other active participation therein, if such conduct be against the rules. This is a refinement of not much practical utility. It is like the old lady and her cat, who were refused admission to a boarding house, unless she agreed to face a very perplexing alternative, "We will let you in," they said, "but, being in, we will have to kill the cat."

The third case, above referred to, was from Illinois—*Pratt* v. *Wheaton College*, a privately endowed institution. Relator's son joined a secret society—The Good Templars—which was against the rules, "and so the teacher turned him out"—suspended him. He applied for a *mandamus* to be reinstated, and was refused, and he appealed. The charter of Wheaton College gave to the trustees no more than the laws of Colorado give to the school directors of high schools—and that was, "power to adopt and enforce such rules as may be deemed expedient for the government of the institution," a "power which," said the reviewing court, "they would have possessed without such express grant, because incident to the very object of their incorporation and indispensable to the successful management of the college." The supreme court of Illinois in passing upon the appeal pronounced the rule forbidding students to join secret societies upon pain of expulsion or suspension a *reasonable* one. It did not doubt the beneficent objects of the Good Templars society, but the right to join it might be surrendered, it said; and the right was surrendered by the pupil under the rule when he joined Wheaton College. The language of this judge is so felicitous that a quotation may be pardoned. He is speaking of the "legal rights" of individuals, a phrase much employed by persons situated similarly to

[1] *40 Ill.*, 186.

the student in this case. "The legal right to do a thing," he says, "means that the law does not forbid the doing of it; not that one may do it at all possible times and under all possible circumstances. A person as a citizen may do what he may not do as a student of Wheaton College." He adds, in substance, that a man may marry, walk the streets at all hours, board at the big hotel, but not if he be a student and the trustees forbid; and they may expel him if he refuses to obey.

It is not to be doubted that the reasoning of this case is applicable to public schools supported by public taxation; it being granted, of course, that the directors of such schools have the legal right to make and have made reasonable rules.

It has been shown above what powers and duties the constitution and laws of Colorado confer upon the school authorities in this behalf, and the constitution and statutes of perhaps all of the states contain substantially similar provisions. Thus, in Illinois, the board of education in the city of Chicago is given "all the rights, power and authority required for the proper management of schools" with "power to expel any pupil who may be guilty of gross disobedience or misconduct."[1] In Illinois also the validity of certain rules of the Chicago school board, pursuant to the foregoing powers, was put to a test in an appellate court, the case being the second of the high-school cases above mentioned. A pupil of the Hyde Park school brought an action, by his mother and next friend, to enjoin the enforcement of a rule of the Chicago board denying to "secret" societies the privileges of school buildings and to student members thereof representation in any literary or athletic contests, etc. The rule, it will be observed, like that of the Denver school board, is modeled after that in question in the Seattle case, *supra;* and, like the appellant there, the Hyde Park student alleged that his natural rights were being infringed and that there was unlawful discrimination against him. The trial court from which the appeal was taken had dismissed the plaintiff's bill for want of equity, and the reviewing court, the Appellate Court of Illinois, First District, unanimously affirmed its decree.[2]

[1] *Stats. Ill.*, Art. VI, chap. 122, §22.

[2] *Wilson* v. *Board of Education, Chicago Legal News*, November 16, 1907.

The appellate court in the above case considered but two points: (1) Had the Board of Education vested in it by law authority to make the rule in question? and, (2) Is the rule a reasonable one? As indicated, the answer to both questions was in the affirmative. The presumption of law is in favor of the reasonableness of rules of boards, the court said, and the burden of proving the contrary rests on the party challenging them, citing *People* v. *Cregier*, *158 Ill.*, 401; and courts, if such rules are reasonable and equal in their operation, will not interpose their judgment or opinion contrary or in opposition to that of the board, which in the promulgation of such rules acts judicially. The cases cited in support of this doctrine are *McCormick* v. *Burt*, *95 Ill.*, 263; *School Trustees* v. *School Directors*, *190 ibid.*, 590.

The state of Minnesota appears to have adopted the most drastic measures against high-school fraternities. By act approved last year the legislature itself of Minnesota forbids any pupil of the public school of the state to become a member of any secret society formed wholly or partially from the membership of the schools, and the same act gives full power and authority in the premises to the school directors, including power to dismiss or to suspend for violation of the rules and regulations of the boards passed in relation to such organizations.[1] The School Board of Minneapolis in September, 1907, promptly availed itself of the powers granted and passed full regulations on the subject; forbidding, among other things, high-school fraternities to be formed, or any pupil to solicit other pupils to become members of such fraternities, or attend their meetings, etc.—the usual enactments, by this time familiar. And the usual injunction was applied for—and refused. A pupil of the Central High School of Minneapolis brought the action, his parents joining with him as citizens and taxpayers.[2] The case in the lower court is not officially reported, but an appeal has been taken to the Supreme Court, and an authoritative exposition of the Minnesota law may ere long be expected. If regard be had to the almost unbroken line of judicial precedents from other states, to which is added the positive command of the Minnesota legislature, the judgment of the Supreme Court of Minnesota may also with some confidence be anticipated.

[1] *Laws Minn.*, 1907, chap. 149.

[2] *Brooks* v. *School Board*, District Court, Hennepin Co., Minn., December, 1907.

THE SCOTCH RAIDS AND THE FOURTEENTH-CENTURY TAXATION OF NORTHERN ENGLAND

By James F. Willard

After the death of King Edward I in 1307, the tide of invasion in the north turned toward England. Year after year the Scots crossed the border, wasting the sparsely settled counties of Northumberland, Cumberland and Westmoreland. At times they advanced farther south into Lancashire or Yorkshire, devastating the country far and wide. Of these forays there are many accounts in the chronicles and in the royal and private correspondence of the reigns of Edward II and Edward III, and it is upon these that the work of the modern historians is largely based. There is, however, another and valuable index to the extent and severity of the inroads of the Scots, in the returns of the taxes upon movable property and in the other financial documents of the period.

The principal tax used by the kings of the fourteenth century was the subsidy levied upon the personal property of all the classes in the country, with the exception of certain kinds of clerical property otherwise taxed.[1] This personal or movable property included the household utensils, the grain, cattle, or goods for sale of noble, freeman and serf. The subsidies were levied in varying percentages of the value of this property, a tenth, a fifteenth, a twentieth or other rate. As the Scots advanced into the country it was these movable goods which would be taken away or destroyed, and as a direct consequence the amount of taxes paid by the men of the north would be lowered. The revenue of the church, after the same fashion, was largely based upon movable property, either directly in the form of gifts, tithes, and produce from their farms, or indirectly upon the rents paid by their villeins, or freemen. So in the case of the ecclesiastics we should expect

[1] Willard, J. F., "The English Church and the Lay Taxes of the Fourteenth Century," *University of Colorado Studies*, Vol. IV, pp. 217–25. 1907.

a like diminution of taxation as the result of the destruction of their taxable property. Upon the basis of the returns from both lay and ecclesiastical taxes, it is possible to gain a concrete idea of the destruction caused by the Scots to place alongside of the generalizations of contemporary writers.

The opening year of the reign of Edward II was a peaceful prelude to the disasters of the later period. Robert Bruce, after the death of the conqueror of Scotland, was busily engaged in his attempt to bring order out of the chaos in which Edward had left the country.[1] The northern counties, therefore, paid to the twentieth and fifteenth of the year 1307, sums which may be taken as standards for the reign of Edward II. Northumberland paid £916 18*s.* 11*d.*; Cumberland, £529 7*s.* 8½*d.*; Westmoreland, £256 7*s.* 10¼*d.*; Lancashire, £397 13*s.* 2¾*d.*; and Yorkshire, £3,867 10*s.* 10¾*d.*[2] The second subsidy of the reign, that of the year 1309, a twenty-fifth, indicated the beginning of trouble along the border. The men of Northumberland paid nothing to this tax, though writs for its collection had been issued.[3] The unrest in the north rapidly increased in intensity. In 1311 and 1312 the whole of the north was ravaged, Durham was sacked, and the men of this district, hopeless of receiving aid from their weak king, were forced to buy peace for themselves.[4] In spite of the fact that he received large amounts of money from loans and a tallage, the king was unable either to meet his expenses or to repel the Scots, and called upon the country for another subsidy, a twentieth and fifteenth, in the year 1313.[5] The result of the two years of disorder are very apparent in the exemption of the men of Cumberland, Westmoreland and Northumberland from making any payments to this taxation.[6] Evidently the same

[1] LANG, A., *History of Scotland* (ed. 1900), Vol. I, pp. 212 ff.

[2] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 2 and m. 2 *d*. For the totals of these counties in 1297 and 1301 see *Yorkshire Archaeol. Society, Record Series*, Vol. XVI, pp. xxi–xxv; Vol. XXI, pp. xx–xxiii.

[3] L. T. R. Enrolled Accounts, Subsidies, No. 14, membranes 3–4. The writs in *Rotuli Parliamentorum* I, 445, 446; *Calendar Patent Rolls, 1307–13*, 183–86.

[4] LANG, A., *History of Scotland* (ed. 1900), Vol. I, p. 215; *Letters from Northern Registers* (Rolls Series), pp. 203–6.

[5] On the gifts and loans see *Cal. Pat. Rolls, 1307–13*, pp. 325, 348, 350, 358, 381, 529; London made a gift of 1,000 marks, *Calendar Letter Books, London*, Letter Book D, p. 252. Writs for the collection of the tallage, *C.P.R., 1307–13*, pp. 520, 521.

[6] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 5. The names of these counties are omitted from this summary of the subsidy, which is sufficient proof that no money was brought into the Exchequer.

condition of exhaustion prevailed throughout the remainder of the reign of Edward II, for in that period the three most northern counties are not credited with any contributions toward the national subsidies.[1] The effect of the forays of the Scots is also to be seen in the exemption from or the lowering of borough ferms,[2] in the deferring of the payments of county debts,[3] in the exemption from purveyance and from attendance at Parliament,[4] and also in the revaluation of ecclesiastical property in the north.[5]

As the invasions penetrated farther into the country toward the south, those counties adjacent to those on the border began to feel the effects of the devastation of the bands of the Scots. The letters of the northern bishops and abbots complain of the burning of the goods on their manors, of the destruction of crops and of the killing of the laborers, so that their manors were ruined.[6] As a result of this destruction Lancashire did not contribute to the subsidy of 1315, but the injury could not have been very great for in 1316 the county paid £242 17*s*. 7½*d*. to the fifteenth and sixteenth.[7] During the years 1318 and 1319 there was a continuation of the forays into Lancashire and Yorkshire, whole districts of these counties being laid waste. Lancashire paid only £81 18*s*. 9¼*d*. to the eighteenth and twelfth of the year 1319, the roll noting in addition that nothing was received from the borough of Lancaster because of the destruction caused by divers raids of the Scots.[8] In the West Riding of Yorkshire some forty vills could pay nothing because they had been ravaged and burned by the Scots.[9] The whole county paid to the same subsidy £2,207 14*s*. 4*d*. as against £3,867 10*s*. 10¾*d*. in 1307, though

[1] I have examined carefully the enrolled accounts of Edward's II reign in L. T. R. Enrolled Accounts, Subsidies, No. 14, *passim*.

[2] *Calendar Close Rolls, 1318–23*, pp. 38, 39, 40, 53, 54, 157, 186; *C. C. R., 1323–27*, pp. 55, 71, 99.

[3] *Calendar Close Rolls, 1318–23*, pp. 190, 233, 299, 307, 460, 686; *C. C. R., 1323–27*, pp. 56, 112, 262, 439, 483, etc.

[4] *Calendar Close Rolls, 1313–18*, pp. 127, 128. Attendance at Parliament, *C. C. R., 1313–18*, p. 205; *Letters Northern Registers* (R. S.), 219, 220.

[5] For an example of the damage caused see *Letters Northern Registers* (R. S.), pp. 279–82. The whole subject of the revaluation of the clerical property has been too fully discussed elsewhere to repeat here.

[6] *Letters Northern Registers* (R. S.), pp. 219, 220, 238, 274, 276, 277, etc.

[7] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 10 and m. 11*d*.

[8] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 13*d*.

[9] *Ibid*., m. 13.

the rate in 1319 was higher. It was during these same years, 1318–19, that the revaluation of the property of the clergy of the province of York was being carried through, the reduction in values being considerable. By the year 1322 Lancashire had again recovered, paying £386 10*s.* 2½*d.* to the tenth and sixth,[1] but in comparison with the amount in 1307 this was far too small, as the rate was about double that of Edward's first year. Yorkshire seems to have suffered very severely, it being noted on the roll that 128 vills in the North Riding had been so burned and devastated by the Scots that they had no goods which might be taxed. The total amount for the whole country fell to £1,896 7*s.* 1¾*d.*, a very serious loss since 1307.[2] The truce for thirteen years signed in 1323 brought a much needed rest to the northern counties for a time.[3]

When Edward III came to the throne in 1327 the trouble with Scotland broke out anew, for the Scots were anxious to gain a recognition of their independence from the young king. Once again war broke out and once again the north was ravaged in the summer of 1327.[4] When in September of that year the collectors of the twentieth, granted in Parliament, were appointed, it was not even thought necessary to select men for the counties of Cumberland, Northumberland and Westmoreland.[5] Both Lancashire and Yorkshire contributed to this subsidy, Lancashire paying £162 11*s.* ¼*d.* and Yorkshire, £1,573 18*s.* 2½*d.*, both of these amounts being far below the sums paid during the first year of Edward II.[6] After the treaty of Northampton, March, 1328, there was another interval of peace which was broken by Balliol's attempt to gain the throne of Scotland. This led to reprisals on the part of the Scots though too late to affect seriously the assessment of the tenth and

[1] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 15*d*

[2] *Ibid.*, m. 14*d*. The totals for the Ridings in 1319 and in 1322 were as follows: East Riding, £866 6*s.* 10½*d.* (1319); £910 4*s.* 0¾*d.* (1322); West Riding, £645 13*s.* 1*d.* (1319); £623 0*s.* 12*d.* (1322); North Riding, £524 5*s.* 6½*d.* (1319); £242 5*s.* 11*d.* (1322); City of York, £171 8*s.* 11*d.* (1319); £120 15*s.* 5*d.* (1322).

[3] LANG, A., *op. cit.*, I, 232; *Calendar Close Rolls, 1318–23*, p. 718.

[4] MACKINNON, *Edward III*, pp. 18 ff.

[5] *Calendar Patent Rolls, 1327–30*, pp. 172, 173. On the Enrolled Account of this subsidy there is no money credited to these counties, L. T. R. Enrolled Accounts, Subsidies, No. 8, m. 1 ff.; while on the memoranda rolls it is specifically stated that nothing came from them; L. T. R. Memoranda Roll, No. 93, m. 1; The entry alongside of each of these counties reads, "de XXma laicorum nec Xma cleri nichil in hoc comitatu."

[6] For these totals see L. T. R. Enrolled Accounts, Subsidies, No. 8, m. 1 ff.

fifteenth granted in September, 1332. Northumberland, however, paid nothing to the subsidy, though collectors had been appointed for that county.[1] After the raids began anew it was given several extensions of time for the payment of the tax, and finally, in June, 1335, it was excused all payment.[2] Cumberland and Westmoreland now paid £538 14*s.* 5*d.* and £189 8*s.* 10½*d.* respectively. The strife of 1332 and 1333 had the effect of again wasting the north, and in 1334 the three border counties paid nothing to the subsidy of that year, the writs to the collectors of the tenth and fifteenth for those counties being vacated on the patent rolls.[3]

After the campaign of 1335 in the north had come to an end, the border counties, if we can judge from the taxation returns, enjoyed a larger measure of peace than they had experienced for nearly a generation. From the tenth year of Edward III to the end of his reign the three northern counties regularly paid their share of the national subsidies whenever they were levied.[4] After the year 1334 Cumberland was, seemingly, the only one of the three to suffer much from the inroads of the Scots and even it always paid a certain amount when subsidies were granted.[5] For a time, however, the total of its taxation decreased. In 1336 the men of the county paid to the subsidy, a tenth and fifteenth, £554 8*s.* 6¾*d.*[6] During the next year Parliament granted the king a tenth and fifteenth to be collected annually for three years. Cumberland paid only £370 13*s.* 1¾*d.*, the reason for this decrease being, as stated in the roll, that the Scots, the enemies of the king, had invaded the county after the tax had been granted, and had perpetrated much burning, depredation, and destruction of the goods of the men of the country, so that they were unable to pay as much as before the raid.[7]

[1] L. T. R. Enrolled Accounts, Subsidies, No. 8, m. 2 ff.; the appointment of the collectors is found in *Calendar Patent Rolls, 1330–34*, pp. 357, 484, 485.

[2] *Calendar Close Rolls, 1333–37*, pp. 85, 303. *Calendar Patent Rolls, 1334–38*, p. 114.

[3] *Calendar Patent Rolls, 1334–38*, pp. 38–40; there is, furthermore, no record of any money having been handed in at the Exchequer, L. T. R. Enrolled Accounts, Subsidies, No. 8, m. 4 ff.

[4] The returns may be found in L. T. R. Enrolled Accounts, Subsidies, No. 8 or in No. 14.

[5] In 1336, and thereafter, Northumberland paid £333 7*s.* 8½*d.* and Westmoreland £190 15*s.* 6½*d.* L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 22*d.* and m. 23*d.* It is interesting to compare these amounts with those raised in 1307.

[6] L. T. R. Enrolled Accounts, Subsidies, No. 14, m. 22*d.*

[7] *Ibid.*, m. 26*d.*

As, since 1334, the amount which each county had to pay when the subsidy was granted remained a fixed sum, it was necessary to gain a writ for a reassessment in a case like that of Cumberland. The writ which authorized the assessment of 1336 states the same reasons for lowering the county total as does the record of the collectors.[1] The second year of the subsidy witnessed a further decrease, the total being £285 19*s.* 7½*d.*, the same reason being assigned for this small amount; while the third year brought in only £249 4*s.* 5¼*d.*[2] With the latter year and amount the taxation of Cumberland reached its lowest point, and for the remainder of the reign of Edward III and afterward, this sum was paid by the county whenever a subsidy was granted by Parliament.

The case of Cumberland in the years of the rapid decrease is made more instructive by the fact that there are preserved in the Public Record Office several of the lists made up in the county, giving the amounts paid by the wapentakes and liberties.[3] When these are even roughly compared they show clearly the direct relation between the forays of the Scots and decreased taxation. The northern and central districts, as indicated by the decrease in taxation, suffered severely from the raids, those most affected being the wapentakes of Eskdale, Cumberland and Leath, the liberties of Penrith and of the bishop of Carlisle, and the socage and city of Carlisle. The districts below the center, protected by the highlands, suffered very little, the best examples being the liberties of Cockermuth and Egremont.[4] It is only natural to expect that after

Wapentake	10 Edward III			11 Edward III			12 Edward III		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Eskdale	54	12	0¼	32	11	3¾	..	..	..
Cumberland	85	13	2¾	44	3	5¾	32	5	2¾
Leath	100	17	0¾	75	0	1¼	53	9	0
Penrith	77	0	0	42	0	0	36	0	0
Allerdale	120	5	10½	79	11	8¼	58	12	0½
Cockermuth	20	7	6¾	20	0	0	20	0	0
Egremont	39	10	6¼	39	10	1¼	35	0	3¼

passing Carlisle the raiding bands should keep to the plains in preference to the hills, and the above results seem to bear this out.

[1] Fine Roll, No. 138 (12 Edward III), m. 31. The writ is dated 4 March, 12 Edward III.

[2] *Ibid.*, m. 29*d.* and m. 30.

[3] These rolls are Lay Subsidies, 90/3 (10 Edward III); 90/4 (10 Edward III); 90/6 (11 Edward III); 90/7 (12 Edward III).

[4] Using the local lists I have made out the following list of typical changes.

A LIST OF THE ENTOMOSTRACA OF COLORADO

By Gideon S. Dodds

The Entomostracan fauna of Colorado has been but little studied and the records up to the present are not numerous. A brief statement of the work that has been done may be of interest. The writer has attempted to summarize all the work which has been done in the state and the following list probably includes all the published records.

Prior to 1902, but 10 species of Entomostraca were known for Colorado. Most of these were listed by naturalists with the "Hayden Survey" during the "seventies." In 1902 Professor Beardsley, of Greeley, Colo., published a list of 34 species known to occur in the state. Of these, 24 species new to the state were from his own collections. In 1904 Birge added 6 species and Marsh added 3 from the collections made by Ward in the Pike's Peak region. A. S. Pearse in 1905 listed one additional species and Beardsley added one. In 1907 Juday from Twin Lakes added 10 to the list and in the same year Marsh gave records of 5 additional species. In 1905 Shantz published some valuable data concerning lakes in the Pike's Peak region but gives no records of the species of Entomostraca collected. The above records include three species new to science: *Diaptomus nudus* Marsh and *Macrothrix montana* Birge from the Pike's Peak region and *Diaptomus judayi* Marsh from Twin Lakes. The writer during the summer of 1907 collected 5 species not hitherto listed from the state. This makes a total of 65 species recorded for the state.

This list is not a long one but very little work has been done. More extensive collections will, in all probability, show the total number in the state to be considerable. The wide range of climatic conditions may be expected to support a corresponding variety of forms. In our foothill and mountain region there are a large number of small lakes at altitudes varying from 6,000 to 12,000 feet. Little is known about the Entomostraca of such lakes in America and systematic study here should be fruitful.

The following list gives the localities from which the species known to occur in the state have been collected. For the records prior to 1902 I have not gone to the sources. I give them as listed by Beardsley. Beardsley's own collections cover quite a number of years and are mostly from the vicinity of Greeley, at an altitude of about 4,600 feet. Here typical plains conditions prevail. Ward's collections were made during the summer of 1903, from a group of lakes near Pike's Peak at an altitude of about 10,500 feet. The conditions here are alpine. The collections by Juday were made from Twin Lakes, during the summers of 1902 and 1903. These lakes have an altitude of 9,200 feet. During the summer of 1907 the writer made collections near La Junta (4,100 feet), near Boulder (5,300 feet), at Tolland on South Boulder Creek (8,850 feet), and from Redrock Lake near Ward (about 10,000 feet).

LIST OF ENTOMOSTRACA KNOWN TO OCCUR IN COLORADO[1]

PHYLLOPODA

Apus longicaudatus Le Conte. (?=obtusus James).

Beardsley considers these two, listed by Le Conte in 1823 and James in 1846, to be the same species.

Apus newberryi Packard.

Little Crow Creek North of Greeley.

Branchinecta coloradensis Packard.

From the mountains of Colorado. Reported by Beardsley from "Hayden Survey."

Branchinecta lindahli Packard.

Near Greeley.

Estheria mexicana Claus.

Collected by Beardsley near La Junta, and in Little Crow Creek north of Greeley.

Eulimnadia texana Packard.

Collected by Beardsley near La Junta.

Lepidurus bilobatus Packard.

Quoted by Beardsley from "Hayden Survey."

Streptocephalus texanus, Packard.

Collected by Beardsley on Mesa de Mayo, Las Animas County.

CLADOCERA

Alona affinis (Leydig).

Pike's Peak; Twin Lakes.

Alona glacialis Birge.

Greeley.

[1] In the following list an asterisk before the name of a locality indicates collections made by the present writer and recorded here for the first time.

Alona guttata (Sars).
Twin Lakes; *Boulder.

Alona quadrangularis (O. F. M.)
*Boulder; *Redrock Lake. I am not sure whether this is different from *A. affinis* from Pike's Peak and Twin Lakes. The specimens measure .35–.5 mm. The claw is smooth with a row of very fine cilia. The claw of *affinis* is regularly toothed.

Alonopsis latissima Kurz.
Near Greeley.

Camptocerus rectirostris biserratus Schoedler.
Twin Lakes.

Ceriodaphnia pulchella Sars.
Pike's Peak; Twin Lakes.

Ceriodaphnia reticulata var. *dentata* Birge.
Greeley; *Boulder.

Chydorus sphaericus (O. F. M.)
"Hayden Survey" (Beardsley). Common about Greeley; Twin Lakes. Occurs in most of my collections about *Boulder and from *Redrock Lake.

[Daphnia brevicauda Chambers]
From "Hayden Survey." Considered by Herrick[1] an incorrectly figured and described *Simocephalus.*

Daphnia dentifera Forbes.
*Redrock Lake; *Tolland. The writer is not positive about this identification.

Daphnia hyalinia Leydig.
*La Junta.

Daphnia hyalinia richardi Bruckhardt.
Twin Lakes. I do not know whether this is the same as the preceding. I have not seen the description of this variety.

Daphnia longispina O. F. M.
Pike's Peak.

Daphnia pulex (De Geer).
Pool above timberline on Mt. Elbert, "Hayden Survey;" Greeley; Pike's Peak; Twin Lakes; Lake on University Campus at *Boulder.

Depanothrix dentata (Euren).
Twin Lakes.

Dunhevidia setiger Birge.
Near *Boulder.

Eurycerus lamellatus (O. F. M.)
Twin Lakes; *Tolland.

[1] Herrick, C. L., *Entomostraca of Minnesota* included in the orders Cladocera and Copepoda. Second report of State Zoölogist, p. 205, 1895.

Graptoleberis testudinaria Fischer.

Twin Lakes; *Boulder. This is common in several lakes near Boulder. The outlines of these specimens is somewhat different from Herrick's figure. I have not seen the specimens from Twin Lakes.

Latona setifera (O. F. M.)

Twin Lakes.

Macrothrix hirsuticornis Norman and Brady.

Twin Lakes. Cushman[1] records this species from Newfoundland and states that this is its first recorded appearance on the Western Hemisphere. This record of Juday's from Twin Lakes is nearly a year earlier.

Macrothrix laticornis (Jurine).

Near *Boulder.

Macrothrix montana Birge.

Pike's Peak.

Moina affinis Birge.

About Greeley.

Pleuroxus procurvatus Birge.

Pike's Peak; Twin Lakes. *Pleuroxus* occurs abundantly in collections from several lakes about Boulder. No two individuals are alike. I am unable to place them.

Scapholeberis mucronata (O. F. M.)

Greeley; Twin Lakes; *Boulder.

Simocephalus serratulus (Koch).

Pike's Peak; *Boulder.

Simocephalus vetulus (O. F. M.)

Greeley; Twin Lakes; *Boulder; *Redrock Lake.

COPEPODA

Actheres carpenteri Packard.

The mountains of Colorado. Quoted by Beardsley from "Hayden Survey."

Canthocamptus minutus (O. F. M.)

Greeley.

Cyclops albidus Jurine.

Greeley; Pike's Peak; Twin Lakes; reported from Wray and Laird by Pearse.

Cyclops ater Herrick.

Greeley.

Cyclops insectus Forbes.

Greeley.

Cyclops pulchellus Koch.

Twin Lakes.

Cyclops serratulus Fischer.

Greeley; Pike's Peak; Twin Lakes; reported from Wray and Laird by Pearse.

[1] CUSHMAN, J. A., "Fresh-water Crustacea from Labrador and Newfoundland," *Proc. U. S. Nat. Mus.* 33, no. 1589, pp. 705 and 709.

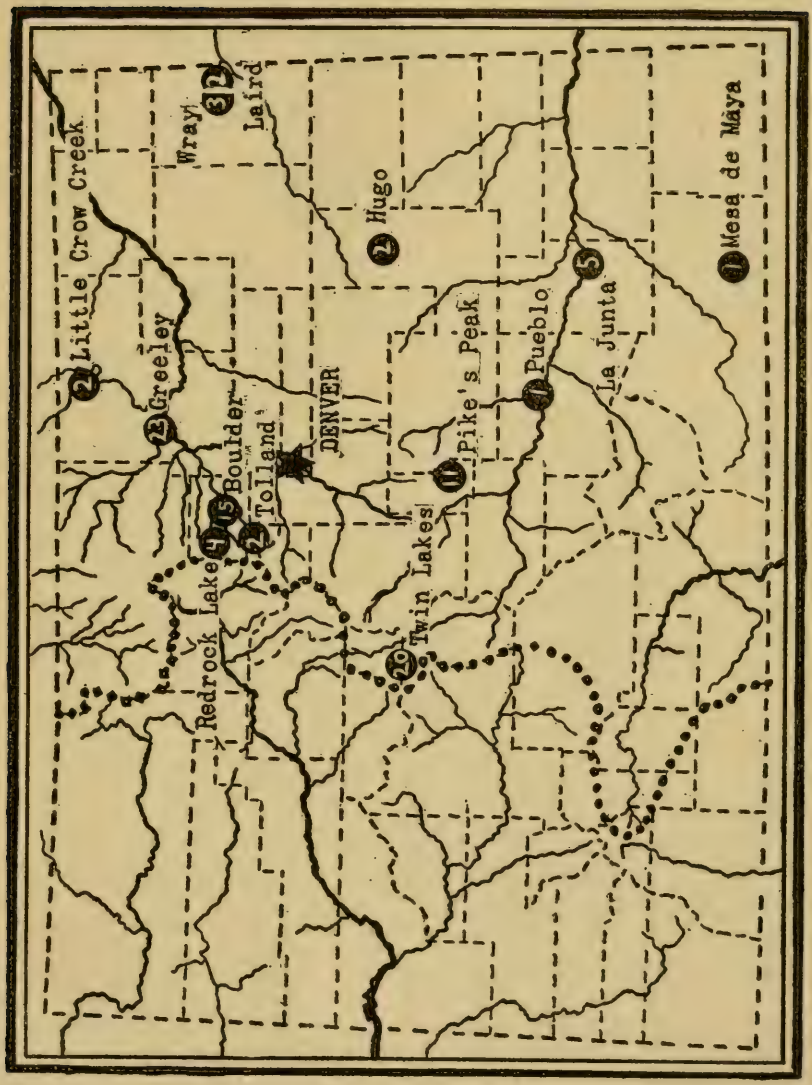

FIG. 1.—Map of Colorado showing places from which Entomostraca have been collected. The numbers indicate the number of species recorded from each locality. The heavy dotted line indicates the continental divide. It will be noticed that all species thus far recorded have been collected east of the divide.

Cyclops viridis var. *americanus* Marsh.
Pike's Peak; Twin Lakes.

Cyclops viridis var. *insectus* Forbes.
Reported from Wray by Pearse.

Diaptomus albuquerquensis Herrick.
Reported from Hugo by Marsh.

Diaptomus claviceps Schacht.
Greeley; *La Junta.

Diaptomus judayi Marsh.
Twin Lakes.

Diaptomus leptopus var. *piscinae* Forbes.
University Campus, Boulder (Marsh); *Redrock Lake.

Diaptomus nudus Marsh.
Pike's Peak; *Boulder.

Diaptomus pallidus Herrick.
Lake Minnequa, Pueblo (Marsh).

Diaptomus shoshone Forbes.
Pike's Peak.

Diaptomus siciles Forbes.
About Greeley.

Diaptomus siciloides Lilljeborg.
Hugo (Marsh); *La Junta.

Diaptomus signicauda Lilljeborg.
Collected by Juday near Boulder (Marsh).

OSTRACODA

Candona acuminata (Fischer).
Greeley.

Cyclocypris laevis (O. F. M.)
Greeley.

Cypria mons (Chambers).
"Hayden Survey" (Beardsley).

Cypridopsis newtoni Brady and Robertson.
Greeley.

Cypridopsis vidua (O. F. M.)
Greeley.

Cyprinotus grandis (Chambers).
"Hayden Survey" (Beardsley).

Cypris altissimus Chambers.
"Hayden Survey" (Beardsley).

Cypris fuscata Jurine.
Greeley.

Erpetocypris olivacea Norman and Brady.
Greeley.

Ilyocypris bradyi Sars.
Greeley.

In the above list, one species, *Daphnia brevicauda*, must be thrown out. In two cases two varieties of the same species are listed separately This makes the total list as follows: Phyllopoda 8 species; Cladocera 26 species; Copepoda 18 species; Ostracoda 10 species. This makes a total of 62 species.

LIST OF WORKS GIVING COLORADO RECORDS

BEARDSLEY, A. E., "Notes on Colorado Entomostraca," *Trans. Am. Mic. Soc.*, Vol. 23; pp. 40–48, 1902.

———, "New American Ostracoda," *Science*, N. S. Vol. 21; pp. 587, 588. 1905.

BIRGE, E. A., Report on the Cladocera, in "A Biological Reconnoissance of Some Elevated Lakes in the Sierras and the Rockies," by Henry B. Ward, *Studies from Zoöl. Lab. Univ. Neb.*, No. 60, pp. 149–51. 1904.

MARSH, C. DWIGHT, Report on the Copepoda, pp. 146–49, in above paper.

———, "A Revision of the North American Species of Diaptomus," *Trans. Wis. Acad.*, Vol. XV, Part II, pp. 381–516, 1907.

JUDAY, CHANCEY, "A Study of Twin Lakes, Colorado, with Especial Consideration of the Food of the Trouts," *Bulletin of the Bureau of Fisheries*, 26; pp. 147–78, 1907.

———, "Studies on Some Lakes in the Rocky and Sierra Nevada Mountains," *Trans. Wis. Acad.*, Vol. XV, Part II, pp. 781–93, 1907.

PEARSE, A. S., "Contributions to the Copepod Fauna of Nebraska and Other States," *Studies from Zoöl. Lab. Univ. Neb.*, No. 65, pp. 145–60, 1905.

SHANTZ, H. L., "A Biological Reconnoissance of the Lakes of the Pike's Peak Region—Preliminary Report," *Trans. Am. Mic. Soc.*, Vol. XXVII, pp. 75–98, 1905.

The following works are those giving records previous to Beardsley's paper. I list them direct, as Beardsley has given them.

CARPENTER, LIEUT. W. L., Report on the Alpine Insect Fauna of Colorado, *7th Ann. Rept. U. S. G. S.* (Hayden), pp. 539–42, 1874.

CHAMBERS, V. T., "New Entomostraca from Colorado," *Bull. U. S. G. S.* (Hayden), III, pp. 151–55, figs. 1–4, 1877.

JAMES, EDWIN, Note 7 (on the Appearance of Crustacea) to Long's Expedition from Pittsburg to the Rocky Mountains, II, p. 336, 1823.

LE CONTE, JOHN, "Description of a New Species of Apus," *Annals N. Y. Lyceum Nat. Hist.*, IV, p. 155, 1846.

PACKARD, A. S., Jr., "Description of a Lernaean Crustacean Obtained by Lieut. W. L. Carpenter in 1873 in Colorado," *7th Ann. Rept. U. S. G. S.* (Hayden), p. 612, 1874.

———, "Synopsis of the Fresh Water Phyllopod Crustacea of North America," *7th Ann. Rept. U. S. G. S.* (Hayden), pp. 613–22, 1874.

———, "Description of New Phyllopod Crustacea from the West," *Bull. U. S. G. S.* (Hayden), III, pp. 171–79, figs. 11–14, 1877.

———, "Monograph on the New Phyllopod Crustacea of North America, with Remarks on the Order Phyllocarida," *12th Ann. Rept. U. S. G. S.* (Hayden), II, pp. 295–593, Pls. I–XXXIX, 1883.

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